WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1) or any other requirements, or both, which may be applicable to the user.

Installation, operation, and maintenance should only be performed by qualified personnel.

PRELIMINARY

TM-112775

VOLUME 1 -- OPERATOR'S MANUAL

SERIES 656

preliminary

DISTURBANCE WAVEFORM ANALYZER

3-1-87

See opposite side relative to proprietary rights.

Note: Refer to Volume 2 (Service Manual) of TM-112775 for maintenance information.

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DRANETZ

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CAUTION

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with this instruction manual, the instrument may cause interference to radio communications. It has been tested and found to comply with the limits for a Class "A" computing device pursuant to Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the instrument is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user, at his or her own expense, will be required to take whatever measures are necessary to correct the interference.

Basic Operational Overview of the Series 656 Disturbance Waveform Analyzer

1/15/87

The Series 656 Disturbance Waveform Analyzer is an extremely powerful, self-contained portable unit which captures, records, analyzes, and displays disturbance events on ac power lines. Displays can be viewed on a five-inch screen or printed for hard copy records using the unit's built in thermal printer.

Monitoring

The Series 656 has four standard ac channels (A, B, C, and D) which monitor ac voltage, neutral-to-ground voltage, or dc voltage on either a low (0 to 60 volts) or high range (60 to 600 volts).

Primary Synchronization Channel

By convention, channel A is the primary synchronization channel. If synchronization is lost on channel A, the Series 656 automatically switches to the next active channel (B, C, or D). The synchronization channel must be set up on the high range (60 to 600 volts).

Event Recording

The Series 656 records an event on a main ac channel with any of three occurrences:

- when a voltage waveform exceeds the sensitivity threshold (V rms), or
- when impulse amplitude exceeds the sensitivity threshold (V peak), or
- when waveform frequency exceeds the sensitivity threshold (Hz).

An event cycle begins when at least one of these three occurrences is detected. The event cycle ends when the line stabilizes.

When the unit is turned on, a reference waveform is determined from the monitored power line for each channel. If, for example, the ac rms voltage is 115 volts and you set the voltage sensitivity to 10 volts, the impulse sensitivity to 50 volts, and the frequency sensitivity to 0.5 hertz, an event would be recorded if any of one these three thresholds is exceeded.

The Series 656 is a true rms computed voltage waveform analyzer. A 7.2 kHz sampler monitors and records waveform changes. A high-speed microprocessor compares the sampled points of the last cycle of the most recent event to the corresponding sample points of each new cycle. There are a total of 120 sampling points on each 60 hertz cycle. If two or more consecutive sample points show a voltage change higher than the programmed voltage sensitivity, the Series 656 records a new event.

Diagnosing Events

Refer to the manual for detailed instructions of each of the below menus. This is simply a brief example of how you could step through the menus to diagnose events.

Events are diagnosed as follows:

1) Starting at the unit's Main menu:

M A I N M E N U

(1) Set Up Parameters....
(2) Examine a Stored Waveform
(3) Plot a Graphic Summary...
(4) Create a Written Summary...
(5) Run Disk Operations...
(6) Other System Functions...
(7) H E L P !

2) If you pressed the [3] key to go into the Plot a Graphics Summary menu, it would appear:

Graphic Summaries Menu

(1) Plot RMS/Impulse Summary
(2) Plot Sensor Channel Summary
(3) Plot Frequency Summary

(6) Return to Main Menu
(7) H E L P !

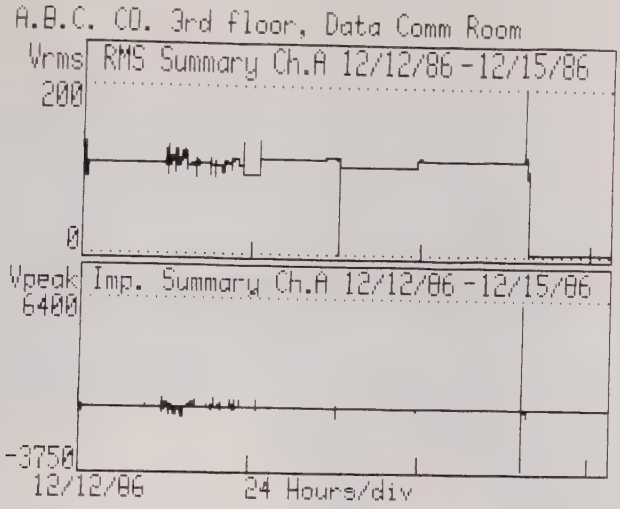
3) If you then pressed the [1] key to go into the Plot RMS/Impulse Summary menu, it would appear:

Plot RMS/Impulse Menu

(1) Channel to be Plotted: A
(2) Plot Previous 24 Hours
(3) Plot Previous Hour
(4) Plot Any Day by Hour...
(5) Plot Multiple Days...
(6) Return to Previous Menu
(7) H E L P !

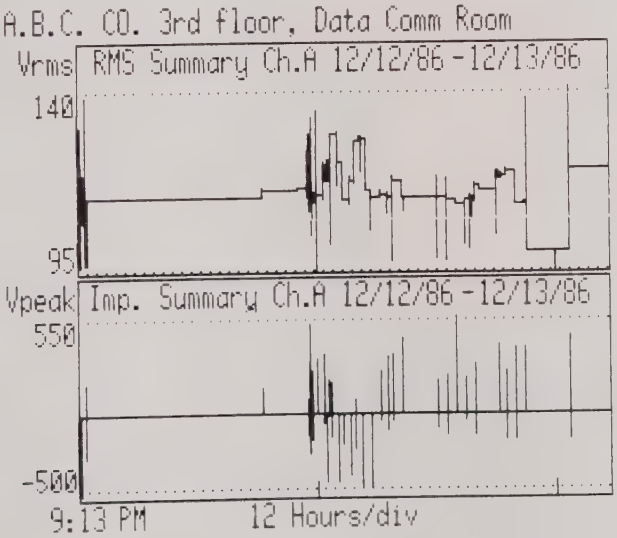
4) Pressing [1] at this point would alternate the channel from "A" to "B" to "C" to "D" to "A", etc. Once the proper channel is displayed, you could then press [2], [3], [4], or [5], depending on the time span you want to examine. (If you are unsure of an interval, pressing the [5] key and then the [RETURN] key twice would display every event in memory.)

A [illegible] (such as the following) would appear:



The above display illustrates rms voltage changes (top) and impulses (bottom) recorded from 12/12/86 through 12/15/86.

5) If desired, you could then narrow the time interval (repeat step 3) for a more specific range. A new display (such as the following) would appear:



The above display illustrates rms voltage changes (top) and impulses (bottom) recorded from 12/12/86 through 12/13/86. Note: Since the first impulse on 12/12 occurred at 9:13 pm, the 24-hour display begins at that point.

6) Once you have an overall picture of the events which have occurred, you could then use the unit to search for specific events according to their time of occurrence (refer to the manual).

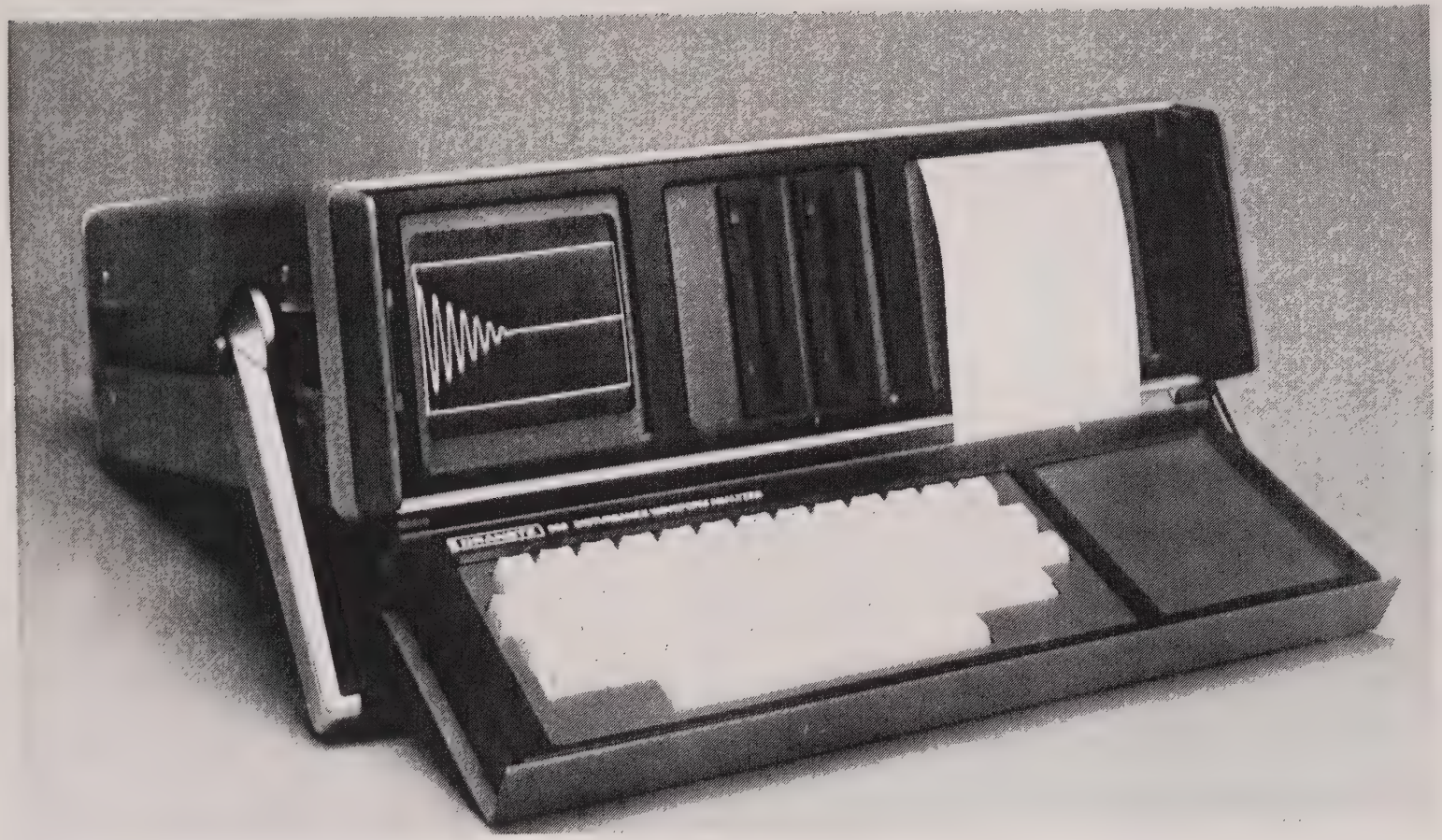


Figure 1-1. Series 656 Disturbance Waveform Analyzer

VOLUME 1
OPERATOR'S MANUAL

SERIES 656 DISTURBANCE WAVEFORM ANALYZER

SECTION I
GENERAL INFORMATION

1.1 SCOPE

This manual consists of two volumes. You are reading Volume 1, the Operator's manual, which is divided into three sections:

I. GENERAL INFORMATION
II. INSTALLATION AND OPERATION
III. OPERATIONAL TEST

Volume 2, the Service manual, contains the maintenance instructions and consists of four sections:

IV. THEORY OF OPERATION
V. MAINTENANCE AND CALIBRATION
VI. REPLACEABLE PARTS
VII. SCHEMATICS AND ASSEMBLIES

1.1.1 General Conventions on Reading this Manual

Buttons and switches are capitalized; keystrokes pressed as commands and function keys such as [RETURN], [SHIFT], [BACK SPACE], etc., are indicated in brackets.

Screen displays of printouts and graphs are set away from the text. All printouts should be read from left to right and from top down.

1.1.2 Using a Keyboard and Touch-Screen

Basic knowledge of a typewriter style keyboard is assumed.

The Model 656 touch-screen allows you to make selections quickly. When making a touch-screen selection, apply gentle pressure with your index finger (or a pointer with rounded edge) to the desired selection line. You can slide you finger up and down the screen (without releasing), and the line you are currently on will highlight. Under some of the Setup screens, if there are several possible parameter selections per line, each will highlight as you move your finger (or pointer) horizontally across the screen. When your selection is highlighted, take your finger (or pointer) off the screen and the function will be selected.

The Series 656 Waveform Disturbance Analyzer has a feature which allows you to specify (by moving an on-screen box) a portion of a waveform you would like to enlarge. The box is called a zoom-box, and it can be moved around the CRT using the touch-screen. To do so, place your index finger (or pointer) on the corner of the box you wish to move in or out, and then slide your finger slowly across the touch-screen. The corner and adjacent sides of the box will move with your finger. When you have moved the two sides of the box to their new position, lift your finger from the screen and they will remain in place.

1.2 INTRODUCTION

The Series 656 Disturbance Waveform Analyzer (see Figure 1-1) is more briefly referred to as the Series 656 or Mainframe. The Series 656 operates on microprocessor based hardware and is a completely self-contained portable unit with features including:

-- Two powerful MC68000 16-/32-bit microprocessors,

-- Menu-driven with continuously accessible "HELP" displays for ease of operation,

-- Four main AC channels,

-- Eight optional sensor channels,

-- Two RS-232C compatible serial ports,

-- A high-resolution CRT with touch-screen overlay,

-- A fold-down, typewriter style keyboard,

-- An integral thermal printer,

-- Dual 3-1/2 inch microfloppy disk drives,

-- A built-in real-time clock,

-- User controlled "ZOOM" capability for detailed transient analysis,

-- One-half megabyte of non-volatile memory for long-term monitoring and data storage, and

-- Five year calibration.

1.2.1 Distinctive Operation

Most analyzers to date print events on paper as they occur. A drawback of this is that it leads to excessive amounts of unwanted data being printed along with paper being wasted.

The Series 656, on the other hand, is distinct in that it internally stores large amounts of event data without necessarily printing or displaying them. When you want to see what events have occurred, you go through the Summarize Events Menu to display them. You can then go to a particular event and view it graphically on the screen. If you then want a paper printout (for reports, analysis, etc.), the Mainframe can print you a copy of the individual event, or a summary of a series of events. Such information is useful for correlating events with their times of occurrence and severities.

In short, the Series 656 gives you both a broad and detailed picture of events. In a broad sense the Unit can display a series of related events, while in a detailed sense it can display a high resolution view of an individual event.

1.3 APPLICATIONS AND PURPOSE

The Series 656 captures, records, analyzes, and displays power line disturbances affecting reliable operation of sensitive electronic, computer-based equipment.

Using the touch-screen CRT or fold-down keyboard, stored power line disturbance waveforms can be instantly recalled and displayed for detailed summary analysis.

Using your index finger (or keyboard) to move the zoom-box, you can define a specific portion of a waveform, and then instantly zoom in for an enlarged view of the boxed region. The smaller your zoom-box, the more it will be enlarged with each "zoom," because the zoom-box expands to a full screen.

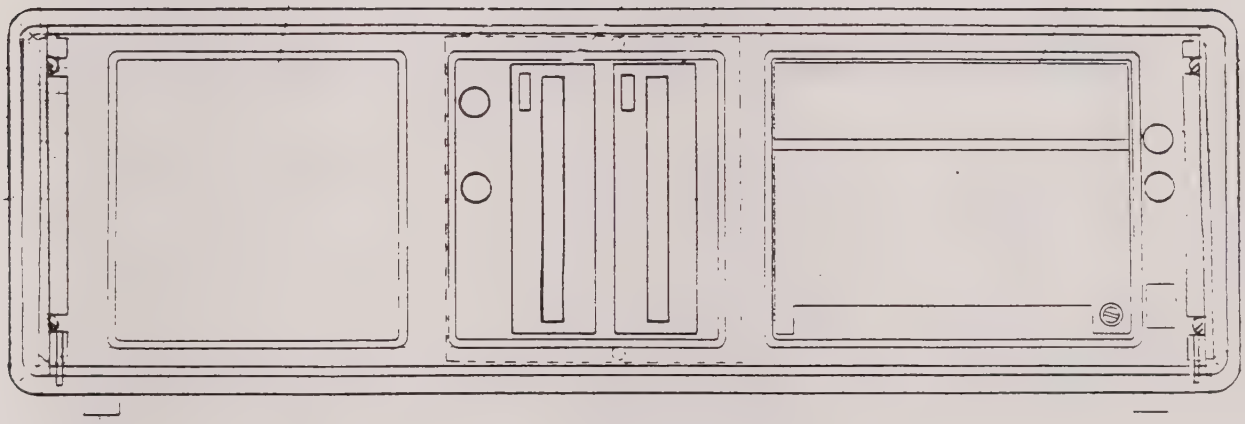
The Series 656 can be preset to select only those disturbance events characterized by your predefined criteria. Once selected, these disturbances can be analyzed on-screen, transmitted to a diskette for filing, or printed on paper. A variety of standard summary report formats are available, and you can also create your own customized report format.

1.4 GENERAL OVERALL DESCRIPTION OF THE SERIES 656

Front and rear panel views of the Series 656 are illustrated in Figures 1-2 and 1-3 on the following two pages.

Subsections 1.4.1 and 1.4.2 list the visible parts of the front and rear panels. (Note that the keyboard is considered part of the front panel.)

Subsections 1.5 through 1.5.10 describe the main sections of the Series 656, including the connecting cables.



(Keyboard Not Shown)

Figure 1-2. Series 656 Front Panel View

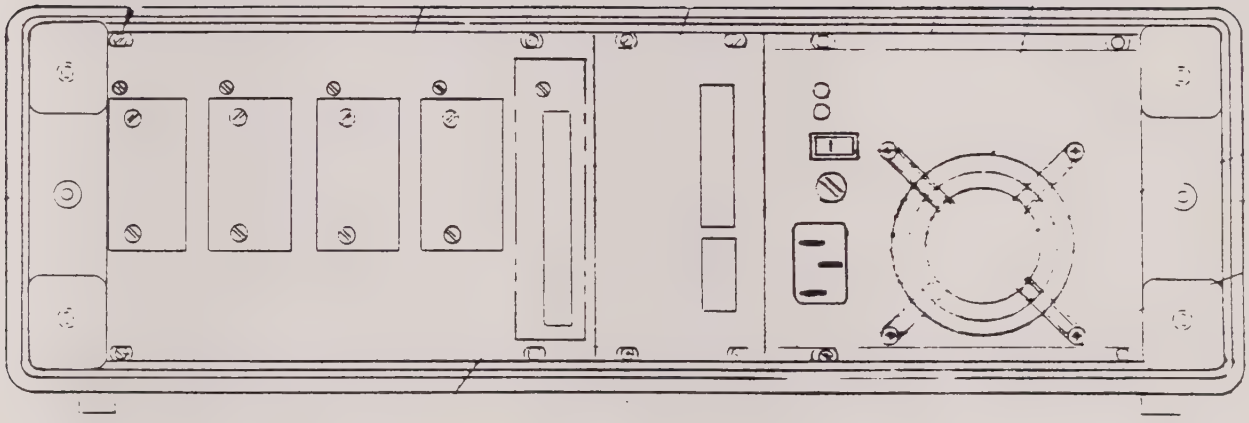


Figure 1-3. Series 656 Rear Panel View

1.4.1 Front Panel

The front panel of the Series 656 is illustrated in Figure 1-2. (Since the keyboard folds down, it is considered part of the front panel.) The basic layout of the front panel is listed in the callouts on the illustration which are identified below.

(A) Five inch high-resolution CRT with touch-screen

(B) A DEFAULT SETUP knob for default setup at power-on

(C) Two 3-1/2 inch microfloppy disk drives:

-- Complete system storage and raw events are stored on the left disk

-- The right drive is used for booting up the Series 656 System Disk; it is also for storing event summaries on a disk inserted into the drive

(D) Thermal Printer

(E) PAPER FEED button

(F) CANCEL (printout) button

(G) Fold-down, typewriter style keyboard

(H) Key lock for securing front cover

1.4.2 Rear Panel

The rear panel of the Series 656 is illustrated in Figure 1-3. (The basic layout of the rear panel is listed in the callouts on the illustration which are identified below.

(A) Power Supply Fan

(B) ON/OFF switch

(C) Battery Charged and Line Voltage Failed LEDs

(D) Power Cord 3-Pronged Receptacle

(E) 25-Pin RS-232C Serial Port (Main Port)

(F) 9-Pin RS-232C Serial Port (Auxiliary Port)

(G) Four Main AC Channel Inputs

(H) Eight Optional Sensor Channel Inputs

1.5 SERIES 656 INPUT AND OUTPUT SECTIONS

The subsections under 1.5 contain information on the input and output sections of the Series 656.

1.5.1 Thermal Printer

CAUTION

NEVER allow the printer to operate without paper; doing so could damage the print head.

A thermal printer at the right-hand side of the front panel provides hard copy printing capabilities. Since the Series 656 has a CRT screen, the printer is a secondary output device.

Waveforms and graphs which you view on the CRT screen, and then want a hard copy of, can be outputted by the thermal printer.

1.5.1.1 Reading the Display

The printer's display is the same orientation as the screen's display: left to right across the page.

1.5.1.2 Changing a Roll of Thermal Paper

(1) Stand the Mainframe in its operating position on a flat surface with its keyboard folded down.

(2) Tear off any remaining paper from the printer, and press and hold the PAPER FEED button to empty any paper left between the print head.

(3) Press in on the center of the printer door and release. This will unlock the printer assembly from its tracks and it will slide out about an inch.

(4) Pull the chassis out until it stops (about 4 inches).

(5) Lift out the empty roll from the U-shaped slots.

(6) Remove the plastic paper spool shaft from the empty roll and install it in a new roll.

(7) Install the new roll, inserted with spool shaft, into the U-shaped slots such that the paper feeds from the back of the roll, going up.

(8) Using scissors, cut a straight edge across the leading edge of the paper.

(9) Feed the paper about a 1/4 inch into the lower "in" feed slot (just above the roll).

(10) Press and hold the PAPER FEED button until the paper goes through the print head and reappears through the "out" feed slot just below the tear-bar (about 3/4 of an inch above the "in" slot).

NOTE

If the paper does not feed evenly, pull it back out and re-feed it (steps 9 and 10).

(11) Slide the printer assembly in until it locks. The paper should be visible just below the tear-bar. If not, press and hold the PAPER FEED button until it comes into view.

1.5.1.3 Paper Take-up Option

If you don't want the printed paper to hang from the unit, you can use the take-up option to accumulate the paper internally.

(1) Press and hold the PAPER FEED button until there is 9 inches of paper hanging.

(2) Unscrew the thumb screw on the printer door and swing the door up, exposing the paper take-up spool.

(3) Remove the take-up spool from the brackets by gently bending out the left-hand clip and pulling the spool down off the right-hand clip.

(4) Using scissors, cut the leading edge of the paper to form a slight point.

(5) Insert the pointed end of the paper into the groove on the paper spool. Wind the paper toward you several times (like loading 35mm film) until the slack is taken up. The winding is clockwise when viewed from your left.

(6) Insert the spool up into the right-hand clip while slightly bending out the left-hand clip, then press in the left-hand clip to lock the spool back into place.

(7) Close the door, tighten the thumb screw, and press and hold PAPER FEED to make sure the paper advances properly.

Removing a portion of Paper from the Take-up Spool

To remove a portion of paper from the take-up spool:

a) Tear the paper at the tear-bar and remove the take-up spool (see steps 2 and 3 above).

b) After removing the paper from the take-up spool, press and hold the PAPER FEED button until there is 9 inches of paper hanging, and then repeat steps 4 through 7 above.

1.5.1.4 Reordering Thermal Paper

Thermal paper for the Series 656 thermal printer, P/N 110888, may be reordered from:

Dranetz Technologies, Inc.
Attn: Order Entry
P.O. Box 4019
Edison, NJ 08818-4019
(201) 287-3680

You may also reorder thermal paper from your authorized Dranetz representative.

CAUTION

Use of thermal paper other than that supplied by Dranetz Technologies, Inc. or it's authorized representatives (P/N 110888) may damage the print head.

1.5.2 CRT with Touch-Screen

The glare-resistant CRT provides menu displays for guiding you through the unit's operation, lists "HELP" screens describing menu choices and what they mean, and displays high-resolution pictures of waveforms. When a waveform is displayed, the CRT also allows you to zoom in on a portion of a waveform to take a closer look. In short, the CRT is the unit's main way of communicating with you.

The touch-screen lets you select information just by touching a portion of the screen. It also lets you define a zoom-box region using your index finger (or pointer) to move the sides of the zoom-box (see Subsection 1.1.2). This simplifies many of the operations.

1.5.3 Dual Microfloppy Disk Drives

The Series 656 has two 3-1/2 inch microfloppy disk drives. The left drive is used for saving and loading system setups and/or events. The right drive is used for booting up the Series 656 System Disk; it is also used for storing and retrieving event summaries on a disk inserted into the drive.

For best results, only use high quality double sided/double density microfloppy diskettes.

1.5.3.1 Cleaning the Disk Drives

After extended use, the disk drives may become dirty and require cleaning. Clean the drives using a quality 3-1/2 inch disk drive cleaning kit.

1.5.4 Keyboard

The fold-down typewriter style keyboard lets you do everything the touch-screen does. In addition, the keyboard lets you enter data and type comments (where applicable). The keys are full-travel and spaced to allow easy typing.

Descriptions of these keys and how they affect Series 656 operation are given in the applicable subsections in this manual.

1.5.5 Power Supply

The Power Supply module in the rear of the Mainframe furnishes the required power; the Series 656 may be operated within 90 to 250 V rms. The supplied power cord attaches to the 3-pronged power cord receptacle on the rear panel. The module is cooled by a built-in fan and an ON/OFF rocker switch turns the Series 656 on and off.

1.5.5.1 Battery Pack

When the Series 656 is on, if the "BATTERY CHARGED" LED is lit, this indicates that the internal UPS (Uninterrupted Power Supply) battery pack is fully charged. If line voltage fails, the "BATTERY OPERATING" LED will light to indicate that the UPS is now operating. The UPS provides a period of uninterrupted Series 656 operation during a power outage.

1.5.6 Communication Ports

There are two serial communication ports located on the rear panel, a Main Port and an Auxiliary Port:

Main Port - 25-pin, "D" type, RS-232C serial port for connection to a CRT terminal, modem, or other input/output device

Auxiliary Port - 9-pin, "D" type, RS-232C serial port for connection to a printer or other output device

1.5.6.1 25-Pin Serial Port (Main Port) Description

The 25-pin connector provides an RS-232C compatible communication port for remote operation of the Series 656 using a CRT terminal, modem, or other I/O device. The port is configured as a DCE (Data Communications Equipment) and is called the Main Port. The definition and operation of the used pins in the 25-pin female "D" connector are described in Table 1-1.

Table 1-1. 25-Pin Serial Port Pinouts

PIN	NAME	FUNCTION	DIRECTION	DESCRIPTION OF OPERATION
1	GND	Protective Ground	Not Applicable	Shield of interface cable should be connected to this pin which is tied to the internal frame ground of the Series 656.
2	RCV	Receive Data	Input	Series 656 receives serial data input from the connected device. RTS & DTR must be TRUE for data to be recognized.
3	XMT	Transmit Data	Output	Series 656 sends output to the connected device, provided both DTR and RTS are TRUE.
4	RTS	Request to Send	Input	This signal must be TRUE for the Series 656 to recognize the presence of the connected device.
5	CTS	Clear to Send	Output	This signal will be TRUE as long as the Series 656 25-pin serial port is operational.
6	DSR	Data Set Ready	Output	Same as CTS
7	GND	Signal Ground	Not Applicable	Internally connected to pin 1.
8	DCD	Carrier Detect	Output (TRUE)	Provided for as a TRUE signal, enabling both sending and receiving.
20	DTR	Data Terminal Ready	Input	This signal must be TRUE for the Series 656 to acknowledge the presence of a connected device. A FALSE state causes immediate disabling of the port.

1.5.6.2 RS-232C Cable for 25-Pin Main Port

Connection of the Series 656 to a CRT terminal, modem, or other I/O device may be made with a Dranetz RS-232C cable (P/N XXXXXX). This cable connects to the 25-pin Main Port on the rear panel. Figure 1-4 illustrates the pinouts and Table 1-1 the descriptions. The cable ties pins 4 and 20 internally. This simplifies connection to a terminal and requires only a logical "high" signal to be fed to pin 20 (DTR).

NOTE

Many of the unconnected pins in the DCE connectors in Figures 1-4 and -5 are internally dedicated in the Mainframe, therefore, they should not be jumpered in any way other than that shown in the two figures.

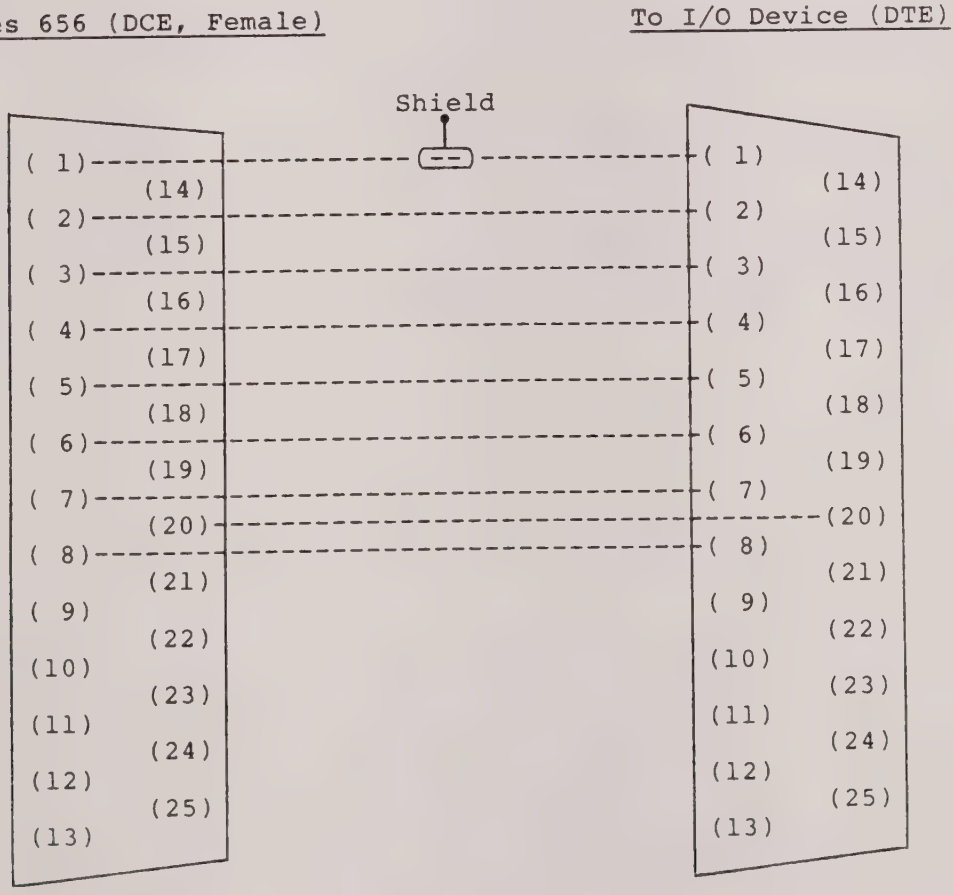


Figure 1-4. RS-232C 25-Pin Interconnect Cable Pinouts (Dranetz P/N XXXXXX)

1.5.6.3 9-Pin Serial Port (Auxiliary Port) Description

The 9-pin connector provides a communication port for remote output using a printer or plotter device. The port is configured as a DCE (Data Communications Equipment) and is called the Auxiliary Port. The definition and operation of the used pins in the 9-pin female "D" connector are described in Table 1-2.

Table 1-2. 9-Pin Serial Port Pinouts

PIN	NAME	FUNCTION	DIRECTION	DESCRIPTION OF OPERATION
1	GND	Protective Ground	Not Applicable	Shield of interface cable should be connected to this pin which is tied to the internal frame ground of the Series 656.
2	RCV	Receive Data	Input	Series 656 receives serial data input from the connected device. DTR must be TRUE for data to be recognized.
3	XMT	Transmit Data	Output	Series 656 sends output to the connected device, provided DTR is TRUE.
4	DTR	Data Terminal Ready	Input	This signal must be TRUE for the Series 656 to acknowledge the presence of a connected device. A FALSE state causes immediate disabling data transfer.

1.5.6.4 RS-232C Cable for 9-Pin Auxiliary Port

Connection of the Series 656 to a remote printer or plotter may be made with a Dranetz RS-232C cable (P/N XXXXXX). This cable connects to the 9-pin Auxiliary Port on the rear panel. Figure 1-5 illustrates the pinouts and Table 1-2 the descriptions.

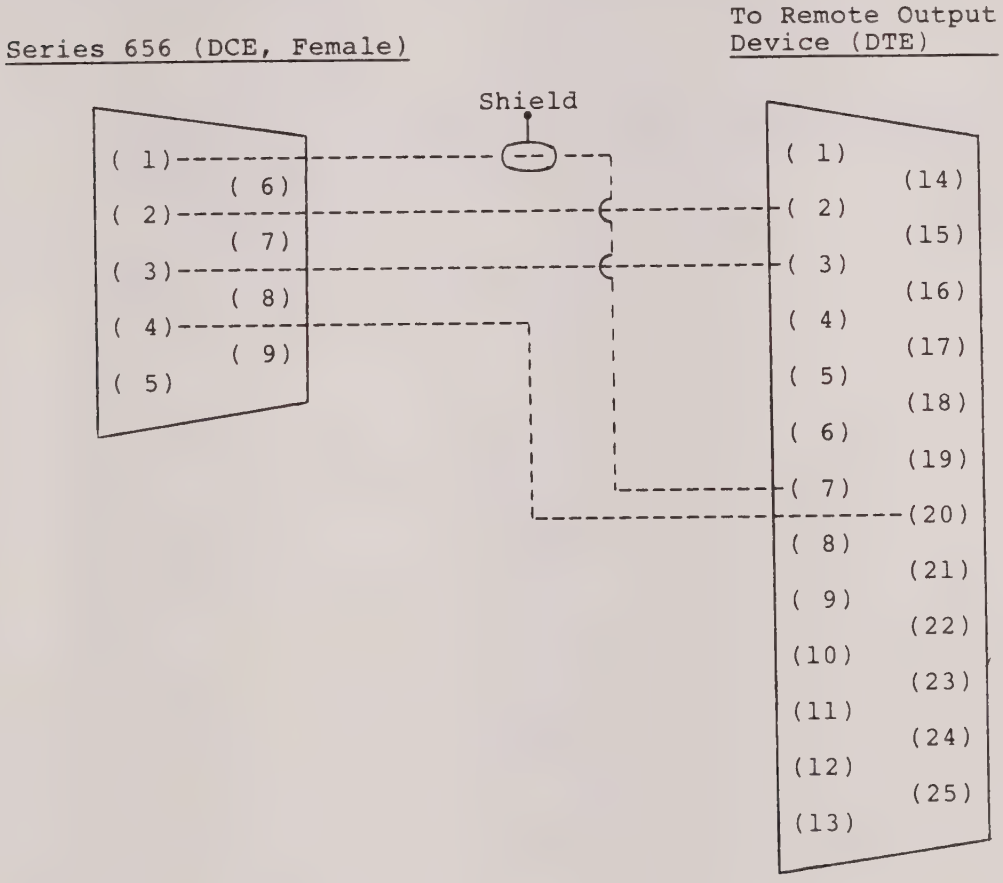


Figure 1-5. RS-232C 9-Pin Interconnect Cable Pinouts (Dranetz P/N XXXXXX)

1.5.7 Main AC Channel Inputs

(For technical specifications, refer to Table 1-3 under Subsection 1.8.)

Four rear panel barrier type terminal strips allow the Series 656 to analyze synchronous, multi-phase ac power lines of 600 V rms or less.

WARNING

> Only uncover the barrier strip(s) when wiring the input terminals (WITH THE SERIES 656 OFF AND ALL POWER DISCONNECTED). At all other times, keep both the used and unused strips covered.

Each strip contains three terminal screws as illustrated in Figure 1-6:

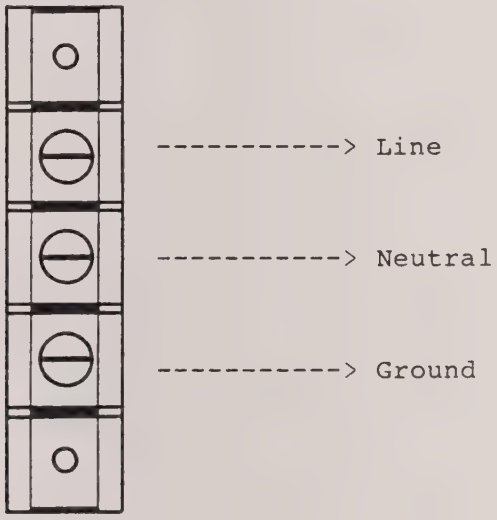


Figure 1-6. Typical AC Channel Inputs Barrier Strip

1.5.8 Optional Sensor Channel Inputs

A single 16-position removable terminal block is provided for wiring up to eight sensor channel inputs for monitoring either 0-5Vdc or 4-20mA type transducers. This connector should be wired prior to insertion into the P.C.B. mounted housing located on the Sensor Monitor assembly. The connections are illustrated below in Figure 1-7.

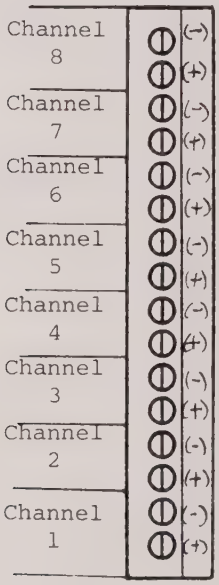


Figure 1-7. Typical Sensor Channel Inputs Barrier Strip

1.5.9 Real-Time Clock

A crystal-controlled (±25 PPM stability), real-time clock is built into the Series 656. The clock is battery backed with an estimated 10-year life. Time is presented as HH MM SS mm (hours, minutes, seconds, tens of milliseconds, and a.m. or p.m. indication). Date is presented in MM DD YY (month, day, year) and day of week indication.

1.5.10 Audible Beeper

Whenever the Series 656 is turned on, and whenever an event occurs, the audible beeper will sound for about one-half second. (The beeper can be turned on and off under the Other System Functions Menu.)

1.6 DATA TRANSMISSION

FUTURE

1.7 REMOTE OPERATION

FUTURE

1.8 SPECIFICATION SUMMARY

Table 1-3 summarizes the specifications of the Series 656.

Table 1-3. Series 656 Specifications (Page 1 of 2)

Operation:	Completely menu-driven
Dimensions:	
Package:	Rugged, portable case with multiposition handle
Size:	6" high by 19" wide by 21" deep (Approx. 15 by 48 by 53 centimeters)
Weight:	45 lbs (Approximately 20.25 kg)
Environmental Specs:	
Operating:	10° to 40°C (50° to 104°F)
Storage:	-20° to 55°C (-4° to 131°F)
Humidity:	10% to 90% (non-condensing)
Time Clock:	Crystal-controlled, ±25 PPM stability. Lists time in MM DD YY mm format and date in MM DD YY format including day of week. (Accurate to within 2 seconds per day.)
Standard Inputs:	Four 2-wire differential main AC input channels
AC Voltage Ranges:	58 to 580 V rms or 5.8 to 58 V rms (selectable)
Frequency:	45 to 65 Hz
Sampling Rate:	7.2 kHz
Accuracy:	±1% reading ±0.2% full scale
Resolution:	1V or 0.1V
Impulse Voltage Ranges:	24 to 6144 V pk
Duration:	Greater than 1 uSec
Sampling Rate:	1.8432 MHz
Accuracy:	±10% reading ±1% full scale
Resolution:	12V at and below 1536 V, 24V above 1536 V
Optional Inputs:	Eight 2-wire multimode scalable, fully differentiable input channels
DC Voltage Ranges:	0 to 10 V dc or 4 to 20 mA dc (selectable)
Sampling Rate:	12 Hz
Accuracy:	±0.5% reading ±0.2% full scale

(cont'd)

Table 1-3. Series 656 Specifications (Page 2 of 2)

Memory:	512K-bytes non-volatile RAM
Disk Drives:	Dual 3-1/2 inch, compatible with double sided/double density microfloppy diskettes
Printer:	High-resolution graphics, 256 dots/line, automatic paper take-up included
Paper:	Thermal, 256 dots per line
User Interfaces:	
Screen:	5-inch monochrome CRT with touch-sensitive overlay for entries
Keyboard:	Full-travel, typewriter style, alphanumeric
Serial Ports:	One 9-pin RS-232C port (Both are 50 to 38.4K One 25-pin RS-232C port baud rate selectable)
Power Requirements:	90 to 250 V rms, 45 to 65 Hz, 100 watts typical
Uninterruptable Power Supply (UPS):	Standard. Provides period of uninterrupted operation in the event of power outage. Six to ten hours typical recharge.

1.9 STANDARD ACCESSORIES

Part #	Quantity	Description
TM-112775 Vol. 1	1	Series 656 Operator's Manual
110888	1	Roll of Thermal Printer Paper
104943	1	AC Line Cord (For customers requesting 115V line cord)
(or)		
110726	1	AC Line Cord (For customers requesting 230V line cord)

1.10 OPTIONAL ACCESSORIES

See step (3) in Subsection 1.11 for information on how to obtain the Volume 2 (Service/Maintenance) manual listed below.

Part #	Quantity Required	Description
TM-112275 Vol. 2	1	Series 656 Service/ Maintenance Manual
	1	RS-232C Cable for 25-Pin Main Port
	1	RS-232C Cable for 9-Pin Auxiliary Port
656-PA-1001	1	8-Channel Transducer Environmental Input Board for the Series 656

1.11 FACTORY REPAIR

When factory is required, proceed as follows:

(1) Contact Dranetz Service Corp. (formerly Dranetz Technologies, Inc., Customer Service Dept.) in order to obtain an authorization number for factory repair.

Telephone No: (201) 755-7081 Telex: 499-7808

TWX: (710) 997-9553 Cable: DRANETZ

(2) Fill out the REPAIR/SERVICE ORDER form enclosed in this manual and ship it along with the malfunctioning equipment to Dranetz Service Corp. If this form is not enclosed, contact Dranetz Service Corp. for a replacement form.

(3) You have been supplied a Control Form with a Registration Number in this Operating Manual. The purpose of this form is to allow you to obtain a Volume 2 manual (Service/Maintenance manual) for your unit. If this form is not enclosed, contact Dranetz Service Corp. for a replacement.

DRANETZ SERVICE CORPORATION
Subsidiary of Dranetz Technologies, Inc.
2259 SO. CLINTON AVE., **BLDG. 1**
SOUTH PLAINFIELD, NJ 07080

TEL. (201) 755-7081
TWX: (710) 997-9553
TELEX: 499-7808
CABLE: DRANETZ

REPAIR/SERVICE ORDER

NOTE: THIS COMPLETED FORM MUST ACCOMPANY RETURNED EQUIPMENT

CUSTOMER SHIPPING & BILLING INFORMATION

CUSTOMER P.O. # _____ P.O. DATE _____

SHIP TO: _____ INVOICE TO: _____

In Continental U.S., material will be returned by Dranetz to you by UPS, UPS Blue or other carrier chosen by Dranetz unless otherwise designated.

EQUIPMENT BEING RETURNED

Date of Original Purchase: _____ Original P.O. # _____

Model No. _____ S/N _____

Model No. _____ S/N _____

Ancillary equipment also being returned (If you neglect this, these items may not be returned to you).

☐ Power & Other Cables _____ ☐ Instr. Book _____

☐ Plug-ins (incl. S/N) _____ ☐ Connectors _____

☐ Other _____

RETURN AUTHORIZATION

Have you discussed the problem with Dranetz Sales or Service personnel?

Dranetz Return Authorization # _____

By: _____

If so, with whom _____ Date: _____

Whom should the Dranetz Service Corporation contact for technical questions?

_____ ( ) _____

NAME (Print) DEPARTMENT TELEPHONE

DESCRIPTION OF PROBLEM

Reason for return: Defective ☐ Calibration ☐

Please be detailed, explicit and complete. Include test data, if this helps to describe the problem.
IMPORTANT: Repairs cannot be made unless this section is completely filled out.
(Attach added sheets if necessary)

CHECK WHERE APPLICABLE: IS MALFUNCTION RELATED TO: Warmup ☐ Temperature ☐
Intermittency ☐ Mechanical Handling ☐ Visual Defects ☐ Grounding ☐ Test Data Attached ☐

INITIATOR OF THIS ORDER

_____

NAME/TITLE SIGNATURE TELEPHONE

(SEE OTHER SIDE FOR INSTRUCTIONS)

IMPORTANT (SEE OTHER SIDE FOR INSTRUCTIONS)

IMPORTANT (ENCLOSE THIS ENTIRE FORM WITH EQUIPMENT)

IMPORTANT: FOLLOW INSTRUCTIONS & USE THIS FORM. IT IS DESIGNED TO HELP US HELP YOU.

1. **Before** returning equipment to our factory, call our Service Corporation **Tel: (201) 755-7081**
   Give the model No., serial number, and information on the problem.

   A. Our specialists may be able to solve your problem rapidly without equipment return.

   B. If equipment return is needed, you will be supplied with appropriate instructions and authorization information to expedite service.

2. If return is to be made,

   A. Fill out the other side of this form **COMPLETELY.**

   B. Enclose original of form INSIDE the shipping carton, preferably attached by masking tape to the equipment.

   C. Ship prepaid (including insurance); we will return prepaid unless otherwise advised by you.

   D. **IMPORTANT** - PACK PROPERLY! SHIPPING DAMAGE WILL BE CHARGED TO YOU!

NOTE:

Statement of Warranty - All products of Dranetz Technologies, Inc. are warranted to the original purchaser against defective material and workmanship for a period of one year from the date of delivery. Dranetz will repair or replace, at its option, all defective equipment returned, freight prepaid, during the warranty period, without charge for repair, provided there is no evidence that the equipment has been mishandled or abused.

FILL OUT OPPOSITE SIDE OF THIS FORM AND RETURN WITH EQUIPMENT.

SECTION II
INSTALLATION AND OPERATION

2.1 GENERAL

This section contains the installation, setup, and operating instructions for the Series 656 Waveform Disturbance Analyzer.

2.2 UNPACKING

Carefully open the upper end of the shipping container and remove its contents. DO NOT discard the shipping container and packaging materials until after inspecting the Series 656 for any shipping damage. Any damage caused by shipping and handling should be immediately reported to the carrier.

In the event that any physical damage does exist, use the original packing case and materials to return the Series 656 to Dranetz Service Corp. This should be done, however, only after an insurance claim has been filed with your underwriter or carrier, or both. Also, before returning any equipment to Dranetz Service Corp., obtain a return authorization number by calling Dranetz Service Corp. (see the REPAIR/SERVICE ORDER form enclosed in this manual).

2.3 INSTALLATION WARNINGS

WARNING

Be sure that the Series 656 is off before proceeding with any installation.

Because of possible shock or fire hazards, connection of this unit should be performed in compliance with the National Electric Code (ANSI C1) and/or any other requirements which are applicable to the user. Installation, operation, and maintenance should be performed ONLY by qualified personnel. Qualifications for performing such procedures should be self-determined.

2.4 SETTING UP THE SERIES 656

Initial setup of the Series 656 involves standing it up, opening the keyboard, making RS-232C connections (if any), wiring the main AC input channels and optional sensor channels (if any), and applying operating power.

2.4.1 Moving the Four-Position Handle/Stand

(1) Place the Mainframe on its rubber feet with its handle facing forward on a flat surface.

(2) With two hands, press in the two outside knobs on the handle/stand releasing it from its locked position.

(3) Raise the front of the Mainframe to one of the three standing positions on its handle/stand.

2.4.2 Uncovering the Keyboard

(1) Face front of Mainframe.

(2) Insert the key in the case panel and turn it one-quarter turn counterclockwise; remove the key.

(3) Gently fold down the keyboard until it comes to rest on the flat surface.

NOTE

When operating the Series 656 in a "dirty" environment, leave the keyboard closed when you are not using the printer, screen, or keyboard. This protects the inside of the unit from dust and other contaminants.

2.4.3 Connecting the RS-232C Cables (Optional)

The next two subsections provide information on connecting RS-232C cables to the Main (25-Pin) and Auxiliary (9-Pin) Ports. Subsection 2.4.3.1 is only applicable if you are using a remote CRT terminal, modem, or other I/O device to operate the Series 656; Subsection 2.4.3.2 is only applicable if you are using a remote printer or plotter to display printouts.

2.4.3.1 Main Port-to-I/O Device Connection

(1) Plug the male end of the 25-pin Main Port Cable (P/N XXXXXX) into the Series 656 Main Port (DCE) connector; plug the female end of the cable into the CRT terminal's DTE connector. (Note: If your CRT terminal has a female connector, a gender changer adapter cable will be required to mate the connection.)

(2) Secure both ends with retaining screws.

2.4.3.2 Auxiliary Port-to-Remote Printer or Plotter Connection

(1) Plug the male end of the 9-pin Auxiliary Port Cable (PN XXXXXX) into the Series 656 Auxiliary Port (DCE) connector; plug the female (25-pin) end of the cable into the remote printer or plotter's DTE connector. (Note: If your device has a female connector, a gender changer adapter cable will be required to mate the connection.)

(2) Secure both ends with retaining screws.

2.4.4 Connecting the Power Cord

Plug the female end of the power cord into the Series 656 rear panel receptacle; plug the male end into an appropriate ac power source.

2.4.5 Wiring the Main AC Channel Inputs

WARNING

Connection should be performed ONLY by qualified personnel, whose qualifications are self-determined. Conductors connecting to measurement points should be approved for the specific use. When connecting to branch circuits of 20 amperes or less, the minimum flexible cord size is No. 18 (1 mm square). For branch circuits with higher ampacity, refer to the National Electric Code, ANSI CI-1975, Paragraphs 2404-4 and 250-95. Refer to Article 250 of the above reference if in doubt. Outside of United States, consult applicable safety standards.

The Series 656 has four main AC channel inputs. Each input consists of a barrier type terminal strip located under a safety cover. To wire each of the AC input channels, proceed as follows:

(1) Turn off the Series 656 and disconnect its power cord.

(2) Turn off the power to the line(s) that will be monitored.

(3) Remove the safety cover of the AC channel barrier strip you are going to wire. (Only remove the one you will be currently working on.)

(4) Read the circuit connection guidelines and circuit applications in Subsections 2.4.5.1 and 2.4.5.2 before continuing.

(5) Connect a line to the three terminal inputs. Connection is as illustrated in Figure 2-1 on the following page.

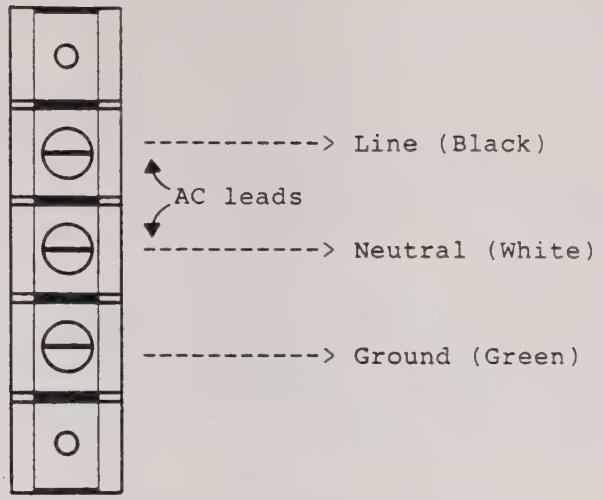


Figure 2-1. AC Channel Wiring

(6) Replace the safety cover of the AC channel you have just wired.

(7) If you are wiring more than one channel, repeat steps 3 through 6 for each additional channel you are wiring.

CAUTION

To avoid damaging the Mainframe, DO NOT apply ac voltages exceeding 600 V rms to the Series 656.

(8) After verifying that all safety covers are in place, reapply power to the line(s) that will be monitored.

2.4.5.1 Circuit Connection Guidelines for the Main AC Channels

Proper monitoring and analysis of ac and dc voltage disturbances requires careful attention to the method of connection between the Series 656 main AC channels and the monitored circuits. To obtain the most accurate and relevant voltage monitoring data, the following guidelines are suggested:

a. Be aware that frequency information is primarily measured on channel A; if channel A fails, it's measured on channel B; if channel B fails, it's measured on channnel C. Never connect channel A from Neutral-to-Ground.

b. As a convention, always connect channel D from Neutral-to-Ground.

c. The ground (Gnd) input only acts as a common grounding point and is internally tied to the Series 656 frame ground. Be careful not to inadvertently contaminate a "clean" ground with a "dirty" building ground. To avoid this, if possible, connect the Series 656's power to the line that is being monitored.

d. To minimize spurious impulse transients and interchannel coupling, always use Dranetz AC channel connector cables.

e. Test cable length should be minimized, preferably eight feet or less, from the AC channel to the circuit connection point. This will minimize the amplitude variation of impulse transients.

f. If you are monitoring a power line connected to critical, sensitive load equipment, the test cable should be connected to the power line as close a possible to the load. For three-phase loads, the Series 656 should be connected in the same way as the load equipment, for example, Line-to-Line or Line-to-Neutral.

2.4.5.2 Circuit Applications for the Main AC Channels

a. The Series 656 can be used to monitor Neutral-to-Ground and Line-to-Neutral voltage in a 120V ac single-phase (1 Ø) system (see Figure 2-2). This application would use two of the four main AC channels (A and D in the illustration).

b. The Series 656 can be used to monitor Line A-to-Neutral, Line B-to-Neutral, and Neutral-to-Ground voltages in a 120V ac split-phase system, while also monitoring Line A-to-Line B voltage in a 240V ac split-phase system (see Figure 2-3). This application would use all four main AC channels.

c. The Series 656 can be used to monitor Line A-to-Line B, Line B-to-Line C, and Line A-to-Line C voltages in a three-phase (3 Ø) "delta" system (see Figure 2-4). This application would use three of the four main AC channels (A, B, and C in the illustration).

d. The Series 656 can be used to monitor Line A-to-Neutral, Line B-to-Neutral, Line C-to-Neutral, and Neutral-to-Ground voltages in a three-phase (3 Ø) "wye" system (see Figure 2-5). This application would use all four main AC channels.

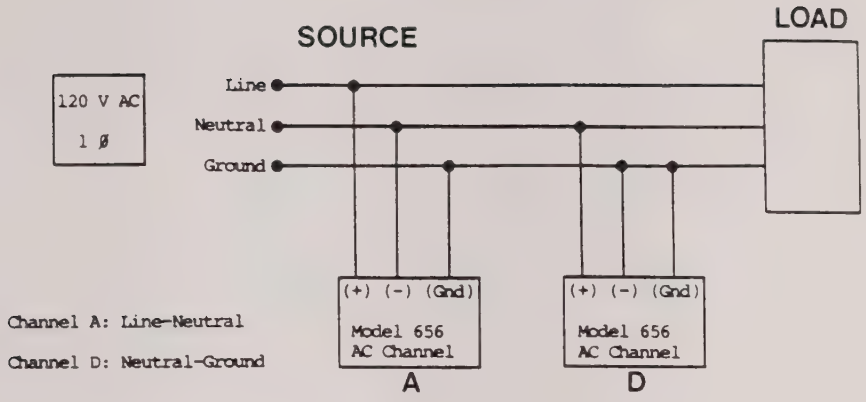


Figure 2-2. 120V AC Single-Phase Connections

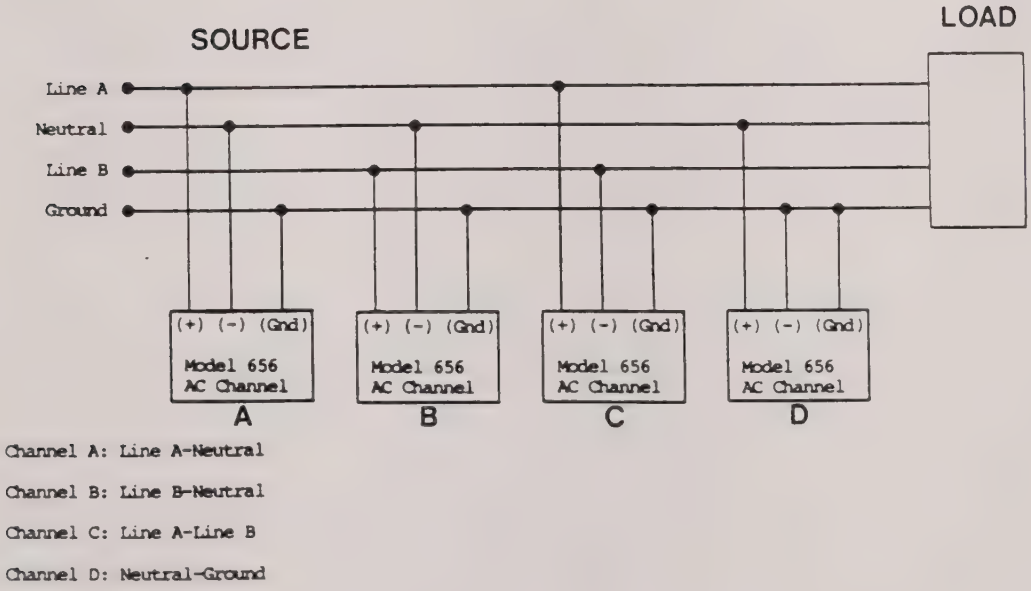


Figure 2-3. 120V/240V AC Split-Phase Connections

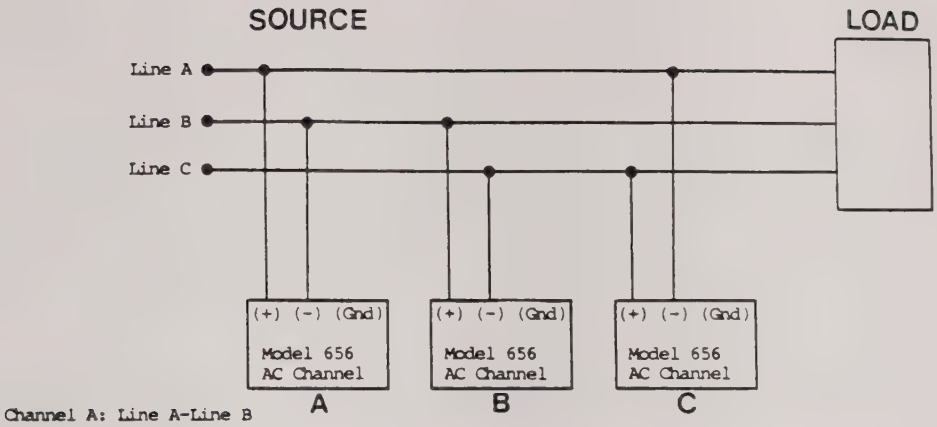


Figure 2-4. Three-Phase "Delta" Connections

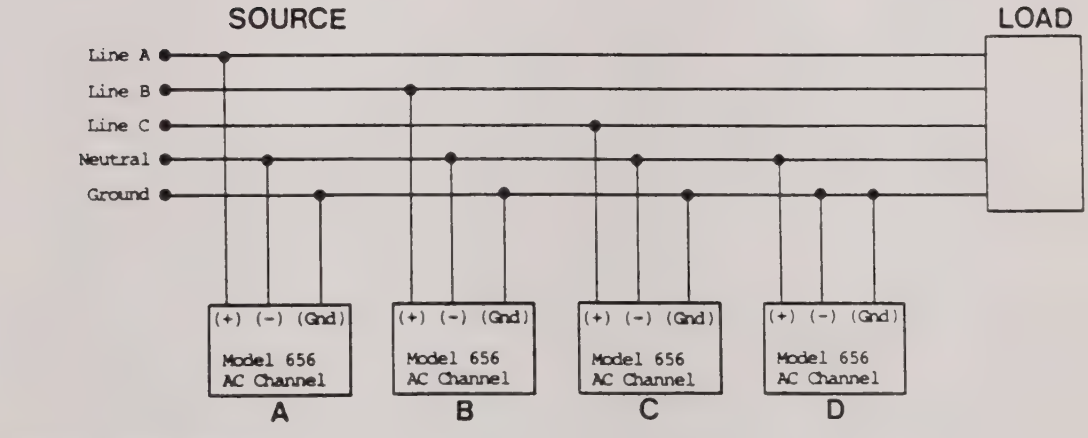


Figure 2-5. Three-Phase "Wye" Connections

2.4.6 Wiring the Sensor Channel Inputs

WARNING

Connections should be performed by qualified personnel only, whose qualifications are self-determined. Conductors connecting to measurement points should be approved for the specific use. If in doubt consult the recommendations provided with the specific transducer or any applicable safety standards.

The Sensor Channel Input assembly for the Series 656 has eight channel inputs. Each channel consists of two positions on the 16-position removable terminal strip. To wire each of the channels, proceed as follows:

(1) Turn off the power from the Series 656 and disconnect its power cord.
(2) Turn off the power to the transducer(s) that will be monitored and any other transducers currently wired to the Sensor Channel Input.
(3) Remove the Sensor Channel barrier strip from its housing.
(4) Read the circuit connections guidelines and circuit applications in Subsections 2.4.6.1 and 2.4.6.2 before continuing.
(5) Identify the proper channel position on the terminal block and wire the transducer as shown in Figure 1-7.
(6) If more than one transducer is to be wired than repeat steps 4 - 5 for each channel to be wired.
(7) When all channels have been wired, re-insert the barrier strip into the housing on the P.C.B. assembly.
(8) After verifying that all connections have been made properly and that the barrier strip is securely in place, reapply the power to the Series 656 and the transducers being monitored.

CAUTION

To avoid damaging the Sensor Channel Inputs, do not exceed rated inputs on any channel. These are +10V or +40mA differential or +/- 50V common mode.

2.4.6.1 Circuit Connection Guidelines for the Sensor Channel Inputs

Proper monitoring and analysis of the transducer voltages and/or currents requires careful attention to the connection between the Sensor Channel Input and the monitored transducer.

a. When using current type transducers, ie. 4-20mA, be sure to observe loop resistance ratings of the transducer. The sensor Channel Input assembly has a maximum loop resistance of 250 ohms.
b. To minimize noise on the input lines shielded cable or twisted pair wire is recomended.
c. When using shielded cable be sure to terminate the shield at one end only, preferably to the frame ground provided on the Series 656 mainframe.
d. Always minimize cable lengths when making connections. This will reduce amplitude variations in the input signal. This is particularly true for current measurements where excessive cable lenghts can increase the loop resistance to unacceptable levels.
e. Although the Sensor Channel Input is designed to operate in common mode environments of up to +/-50V it is recomended that all attempts be made to minimize this voltage. This will ensure more accurate and reliable readings.

2.4.6.2 Circuit Applications for the Sensor Channel Inputs

FUTURE.

2.5 BEGINNING OPERATION USING THE SERIES 656

At this point, it is assumed the Series 656 has been properly connected and is ready for operation. Operation of the unit, including parameter setups, is performed through a system of self-prompting menus and screens which are discussed in the subsections below. Although not shown in this manual, the current time, date, and day of week are displayed at the bottom of most screens.

2.5.1 Initial Start-Up

Set the DEFAULT SETUP knob on the front panel to the setup number you want as the default when the Series 656 first boots up.

Turn the Series 656 ON. It will automatically perform a diagnostic self-test, checking out the integrity of its various subsystems. Any malfunctions detected are listed descriptively. (See Section III for further instructions if this occurs.) If none are detected, the unit's Start-Up screen will be displayed.

2.5.1.1 Start-Up Screen

The Start-Up screen (not shown) displays the version of software installed, and prompts you to insert the Series 656 System Disk into the right-hand disk drive and to press any key to continue.

2.6 OPERATING THE SERIES 656

Insert the Series 656 System Disk into the right-hand drive and press any key. The program will take several seconds to load. After it is loaded, the Series 656 Main Menu will appear (described in the following subsection).

2.7 MAIN MENU

The Main Menu is the top menu in the Series 656 Menu Structure (see Figure 2-7). From the Main Menu you can go down to any menu or Setup screen in the structure.

M A I N M E N U

(1) Set Up Parameters....
(2) Examine a Stored Waveform
(3) Plot a Graphic Summary...
(4) Create a Written Summary...
(5) Run Disk Operations...
(6) Other System Functions...
(7) H E L P !

Making a Selection Using the Touch-Screen

Menu selection using the touch-screen is described in Subsection 1.1.2. To briefly review, when you place your index finger (or pointer) anywhere on a selection line, the entire line will highlight. You can move your finger (or pointer) up and down the screen, and each line will highlight as you come to it. When you remove your finger(or pointer) from the screen, the line currently highlighted will be the selection the Series 656 will go to.

If you prefer using the keyboard for menu selections, the numeric keys correspond to the menu selection numbers in parentheses. For example, pressing the [1] key while in the Main Menu puts you in the Setup Parameters Menu.

Possible Selections and What They Mean

Selection: (1) **Setup Parameters Menu**

Application: The Setup Parameters Menu allows you to change the main and sensor channel setups. From this menu you can also go to the System Parameters Menu (see Subsection 2.7.1.1), where you can change system parameter setups: Main Port, Auxiliary Port, Internal Printer Options, External Printer Options, and Beeper Status.

Subsection Described in is 2.7.1

MAIN/SENSOR CHANNEL SETUPS OVERVIEW

The Main Channel Setups and Sensor Channel Setups menus provide the user with a simple means of examining and changing the Setups used to monitor,
control and annotate the four AC (Main) and eight DC (Sensor) inputs. Upon entry to these menus the context sensitive HELP feature may be used by the user to step himself through the proper operation of these menus. Brightness and reverse video are used to provide feedback for the touch screen user and to "point" the user to proper sequence of inputs needed to change a setup entry. All changes to these menus that require text (numerical) input are checked for legality. If an illegal (out of range) entry is attempted the entry will be discarded and a help message summarizeing the legal range for the input in question is displayed. Following are some general rules and suggestions for proper use of the menus.

a. WHEN USING THE TOUCH SCREEN the line or function that is being tenatatively selected will appear in bright reverse video. DO NOT LET GO UNTIL THE VIDEO IS STABLE. Upon letting go the line selected for change will appear in bright video and for most cases the text/data to be changed will appear in bright reverse video.

b. All single letter commands from the keyboard (such as "H" for HELP) are case insensitive.

c. HELP may be selected at any time by typing "H" or by touching the screen over the HELP text. The help message displayed will refer to the setup line currently open for change. If no line of setup information has been selected for change the help message will be a general operational description. The one exception to the rule is when a setup line is selected to change a channel input descriptor. In this situation Help is only available via the touch screen.

d. A setup line may be exited by using the RETURN key, CONTROL C, or by SELECTING ANOTHER LINE for input. If you are making an entry and you change your mind and decide you wish to leave the entry as is: use control C. Reselection of a line that is already selected will also cause the line to be exited.

e. You may eXit or Return to the Setup Parameters Menu at any time by hitting the "R" or "X" key or by touching the "Return to Setup" text on the screen. The exception to this rule occurs while entering descriptor text. In that situation the touch screen only, may be used to return to the Setup Parameters

Menu. If a setup change is in progress when an Exit to Setup Parameters Menu directive is issued the change will be discarded.

f. When entering alphanumeric text BACKSPACE and CONTROL X are supported. Control X deletes all the text input. Backspace deletes the last character input.

What follows is a detailed description of the setup operation.

Main Channel Setups
****

The Main Channel Setups menu provides a display of the sixteen possible setups that may be used to monitor the four main AC input channels (Channels A, B, C, D). It is entered from the Setup Parameters Menu by typing one [1] or by touching the screen over top of the Main Channel Setups text. On initial entry into the Main Channel Setups menu the currently active setup is displayed, i.e. the setup that is currently being used to monitor the AC inputs is the setup displayed on entry. On shipment from the factory these setups are pre-programmed with 16 different alternative setups. The user may invoke the use of a specific setup via the Initiate Setups Menu which may be accessed via line four of the Setup Parameters Menu. On entry into the Main Channel Setups Menu a typical setup display will appear as follows:

```
        Main Channel Setups
1 Setup #07     A     B     C     C
2 Channels     On    Off   On    Off
3 Range        Hi    Lo    Hi    Lo
4 Impulse    0100  0100  0100  0100
5 Voltage     005   005   005   005
6 Frequency   0.1 (All Channels)
7 Descrip. 230V Split Phase A:LineA-Neut B:LineB-Neut
(R)eturn to Setup Menu     (H)elp
```

When no line of setup is selected for change (such as on initial entry) one may:

1. SCROLL FORWARD to examine the next setup by pressing the plus [+] or right arrow [>] key or by touching the screen over the setup number (#07 in the sample setup shown here). Repeated forward scrolling will wrap-around to setup number 1 when an attempt is made to scroll past setup number 16.

2. SCROLL BACKWARD by pressing minus [-] or left arrow [<]. Backward scrolling is only available from the keyboard.

3. SELECT HELP by pressing H or h or by touching the screen over top of the (H)elp text. The help message in this context will give an overview of the menu operation similar to the text at the beginning of this section.

4. RETURN TO THE Setup parameters Menu by pressing X, x, R or r or by touching the screen over top of the "(R)eturn to Setup Menu" text. This option is ALWAYS available no matter what menu function you are performing. However, if descriptor text is being changed (line 7) then the RETURN option is only available via the touch screen.

5. SELECT A LINE of the setup menu for alteration by touching the screen over the desired line number or by typing the line number.

What follows is a line by line description of the setup editing options.

LINE 1: Setup #

Upon selection of line 1, "1 Setup #" will appear in bright video and the setup number will appear in bright reverse video. When line 1 is selected You may scroll forward or backward exactly as described previously or you may select a setup to be displayed explicitly by typing in a number from 1 to 16. Backspace and Control X are functional. Selection of Help while in line 1 will display text similar to what is here. Exit by pressing carriage return or control C or by selecting another line for editing (via the touch screen).

LINE 2: Channels

The CHANNELS function is a toggle function that allows the user to selectively turn an input A, B, C or D On or Off. Upon slection of the Channels function, line two appears in bright video and the A, B, C and D headers appear in reverse video to signify pushbutton selections. To toggle a input from On to Off or from Off to On type or touch A, B, C or D. The respective input status will toggle to the opposite state. Note that the 656 Disturbance Analyzer will never allow all inputs to be Off simultaneously. Suppose the input setup was as follows:

CHANNEL	A	B	C	D
STATUS	Off	Off	Off	On

If you wished to turn input A On and B, C, D Off with the above setup as a starting point you must first toggle A On and then toggle D Off. A reversed sequence would generate an error message because at least one input must be On. TO EXIT line 2 use carriage return, control C or select another line for editing.

LINE 3: Range

Range is a toggle function that allows one to select either a HI or LOW front end range setting for the input voltage monitoring. Operationally, Range editing is done in the same fashion as Channel On/Off setting (LINE 2). Additionally, since the range of the voltage thresholds are functionally related to the input range setting a change of the input range automatically changes the associated voltage threshold (LINE 5). i.e. Assume the Voltage threshold for channel input A is initially 5 (LINE 5 COLUMN A) and the Range setting is set to Hi. If you were now to toggle the Range from Hi to Lo the Voltage threshold would be automatically divided down by 10 and set to 0.5. Whenever a Range setting is changed LINE 5 is modified and displayed in bright video to flag the change to the associated Voltage threshold. When toggleing from the Lo to Hi input range, the Voltage threshold is multiplied by 10.

LINE 4: Impulse

To edit the Impulse thresholds first select the Impulse threshold line by touching line 4 or by typing a four [4]. Upon selection of line 4 the line will appear in bright video and the channel A, B, C and D headers will appear in dim reverse video. Threshold channel selection is made by touching or typing the desired channel letter. A channel selection will cause the threshold for the selected channel to appear in bright reverse video to signify that the threshold is open for changing. Type in the desired threshold. The entered data will appear in bright video and the remaining digits will be in reverse video. Legal inputs for the Impulse thresholds are integer voltage values between 24 and 6124 volts. The following are examples of legal keystrokes appropriate for setting A to 30V, B to 30V, C to 6000 and D to 300 volts.

4 A 30 B 0030 C 6000 D 300 [Carriage return]
4 a 30 [RET] 4 B 30 [RET] 4 c 6000 [RET]D 0300[Control C]

Note: Spaces need not be included in the actual key sequence, they are here for clarity only. Values between the [] constitute a single keystroke. Channel letter entries (A, B, C or D) may be entered via the touch screen.

Backspace and Control X are functional when the actual threshold data is being entered. They may not be used to deselect the channel or the line. If the maximum number of threshold digits (four) are entered the input is automatically

saved and recorded. An incomplete input may be deleted at any time with a Control C (discard and exit line) or Control X (discard input and prepare for new). Whenever there is no channel selected for editing a new menu line may be selected by either the keyboard or touch screen. If a threshold input is in progress a new line may only be selected via the touch screen.

LINE 5: Voltage

Operation of Voltage threshold editing is operationally identical to that of the Impulse thresholds. (See previous text) The legal range for the Voltage threshold is a function of the input Range setting. If the input Range is set to Hi then enter an integer between 002 and 600 volts. If the input Range is set to Lo enter a number between 00.2 and 60.0 volts. Leading zeros are not required.

LINE 6: Frequency

Select line 6 by typing a six [6] or by touching the screen over line six. The line will appear bright and the threshold will be in reverse video. Enter a threshold from 0.1 to 9.9 Hz. Exit via carriage return, control C or by selecting another line (from the touch screen only).

LINE 7: Descrip.

Line 7 provides the user with the ability to specify an alpha-numeric descriptor to accompany the various summaries of the main input data. Selection is made by touching the screen over line 7 or by typing seven [7]. Upon selection of line seven the line appears bright and the descriptor portion is in reverse bright video. Useing the keyboard one may enter up to a 42 character descriptor from the ASCII set $20 to $7E (hex). Control X and backspace are completely functional. Control C may be used to exit the line without altering the original text. Exiting line 7 with carriage return will save the new text if any was entered otherwise the original text will be preserved. If all 42 character positions are used the new text will be saved upon entry of the fourty second character. Note that the HELP function is only available via the touch screen. The (R)eturn to Setup Menu directive is also only available via the touch screen while line 7 is active.

Sensor Channel Setups
****

The eight Sensor Channel Setups menus provide the user with a means of setting the measurement, monitoring and annotation parameters of each of the eight DC sensor inputs. The editing facilities of these setups are functionally identical to those described previously in the Main/Sensor Channel Setups Overview. However it is significantly simplified by the

elimination of the need to specify a specific channel input. As described previously, the context sensitive Help feature may be used to step oneself through a setup edit on site. On entry to the Sensor Channel Setups via line 2 of the Setup Parameters Menu the following typical display may appear:

```
     Sensor Channel Setups
(1) Channel ..... 1
(2) Status ..... On
(3) Span Value .... +04095
(4) Zero Value .... +00000
(5) Units ..... Counts
(6) Sensitivity ... 01%
(7) Return to the Setup Menu
(8) H E L P !
```

The following is a breif discussion of the use of the Sensor Channel Setups menu. In virtually all cases the editing options of the Sensor Setups Menu follows the same procedure as the Main Channel Setups. Refer to the Main Channel Setups section for operational details if neccessary.

LINE 1: Channel

To SCROLL FOWARD through the eight setups use the plus [+] or right arrow [>] key or touch the screen over the channel number. To SCROLL BACKWARD use the minus [-] or left arrow key [<]. Selecting line one allows explicit selection of the menu desired.

LINE 2: Status

The Status setup allows one to set the input to On or Off. Status is a toggle function that is operated by selecting line 2 and then hitting any printable ASCII key. The Status will toggle from On to Off or from Off to On. While Status is selected the toggle may also be accomplished via the touch screen by touching the On/Off text. Exit the Status function with a carriage return, control C or by selecting another setup option.

LINE 3 and 4: Span Value and Zero Value

Span and Zero Value in combination with the Units annotation are used to fit the voltage output of the input transducer to a linear equation and generate appropriate enginneering units. Span refers to the nearest integer engineering units output of a tranducer at the full scale (10 volts) of the input. The Zero Value refers to the nearest integer enginneering units output of a transducer at 0 volts of the input. Span and Zero value setups are signed integers that may range from -32768 to +32767. Some examples will serve to explain proper use of these setups.

Suppose a temperature transducer is installed that is calibrated to output 10 volts DC at 100 degrees C and 0 volts at 0 degrees C. In this simple application the Span Value would be 100 and the Zero Value would be 0. Entering "deg C" into the Units descriptor on setup line 5 would generate measurement outputs appropriately annotated in degrees C.

A more typical and slightly more complicated application is when the full scale output specification of a transducer is less than the full scale of the 656 Transducer input (10volts). Suppose a similar transducer is calibrated to output 6 volts at 100 degress C and 0 volts at 0 degrees C. In this situation the Span Value would be the temperature necessary to produce 10 volts out of the transducer assumeing it was linear and it could go that high. Projecting the output to 10 volts would give 10/6 times 100 for a Span Value of approximately 167. The Zero Value would still be 0 as in the first example. In both examples one could multiply the Zero and Span Values by 10 and put "C * 10" (degrees C times 10) in the units to get an equally valid setup.

The formulas for computing the Span and Zero values for a arbitrary transducer where at least two points are specified are as follows:

Span Value = [(EUF-EUL)/(VF-VL)]*10 + [(VF*EUL)-(VL*EUF)]/(VF-VL)

Zero Value = [(VF*EUL)-(VL*EUF)]/(VF-VL)

Where:

*	=	denotes algebraic operater multiply
/	=	denotes algebraic operator divide
EUF	=	magnitude in engineering units at the full (high) scale of the transducer.
EUL	=	magnitude in engineering units at the low scale of the transducer.
VF	=	full scale voltage output of the transducer
VL	=	low scale voltage output of the transducer

EUF, EUL, VF and VL or equivalent information is generally supplied with the transducer literature. The computed Span and Zero values must be rounded off to the nearest integer before entering them into the setup. It is permissable to multiply the Span and Zero values by a factor of 10 before entering them into the setup as long as the resultant is within the range of -32768 to +32767. In conjunction with appropriate annotation of the Units (line 6);this is a good way to reduce roundoff error while preserveing the intelligibility of resultant displays. Other factors may be used at a possible cost of reduced readability.

LINE 5: Units

The Units is a six character descriptor used to describe the engineering units output of the transducer relative to the chosen Zero and Span value setup. Editing is accomplished by selecting line 5 and then typing in the descriptor. Exit with a carriage return.

LINE 6: Sensitivity

Sensitivity is used to set a transducer fault threshold as a percentage of full scale. After selecting line 6 enter a integer percent from 01 to 99. Exiting with a carriage return or by selecting another setup line will save the new threshold.

LINES 6 and 7: Return to the Setup Menu and H E L P !

Lines 6 and seven operate the same as in the Main Channel Setups. They may be invoked at any time via the touch screen. Except during text editing (Units - Line 6) they may be accessed with H, h (HELP) or X, x, R, r (Return).

Selection: **(6) Return to MAIN MENU**
(from Setup Parameters Menu)

Pressing row (6) on the touch-screen or the [6] key will put you back to the Main Menu.

Selection: **(7) H E L P !**
(from Setup Parameters Menu)

Pressing row (7) on the touch-screen or the [7] key will bring up a "HELP" screen which gives you a brief description of your possible selections from the Setup Parameters Menu and what they mean.

2.7.1 System Parameters Menu

Pressing row (3) on the touch-screen or the [3] key while you are in the Setup Parameters Menu (see Subsection 2.7.1) will produce the System Parameters Menu:

System Parameters Menu

(1) Main Serial Port Setups
(2) Aux. Serial Port Setups
(3) Internal Printer Options
(4) External Printer Options
(5) Toggle Event Scanning On/Off
(6) Return to Setup Param. Menu
(7) H E L P !

Selection: **(1) Main Serial Port Setups**
(from System Parameters Menu)

(1) -- Pressing row (1) on the touch-screen or the [1] key will produce a listing of the Main Serial Port setups such as the following:

Main Serial Port Setups

Sorry, these functions not supported
in the current software.

(6) Return to System Param. Menu
(7) H E L P !

(1) through (5) -- These selections would normally allow the user to change the default setups. However, this version of software does not support the Serial Port Setups. It is expected that some future version will support these functions.

(6) -- Pressing row (6) on the touch-screen or the [6] key will put you back to the System Parameters Menu.

(7) -- Pressing row (7) on the touch-screen or the [7] key will bring up a "HELP" screen which gives you a brief description of your possible data format selections.

Selection: (2) Auxiliary Serial Port Setups
(from System Parameters Menu)

(2) -- Pressing row (2) on the touch-screen or the [2] key will produce a listing of the Auxiliary Serial Port setus such as the following:

Auxiliary Serial Port Setups

Sorry, these functions not supported
in the current software.

(6) Return to System Param. Menu
(7) H E L P !

The present version of the software does not support the capability of changing the Auxiliary Serial Port setups. It is expected that future versions may support these functions.

(6) -- Pressing row (6) on the touch-screen or the [6] key will put you back to the System Parameters Menu.

(7) -- Pressing row (7) on the touch-screen or the [7] key will bring up a "HELP" screen which gives you a brief description of your possible data format selections.

Selection: (3) **Internal Printer Options**
(from System Parameters Menu)

(3) -- Pressing row(3) on the touch-screen or the [3] key will produce a listing of the Internal Printer Options such as the following:

```
                    Internal Printer Options

                Sorry, these functions not supported
                in the current software.


                (6)  Return to System Param. Menu
                (7)  H E L P !
```

Presently, there is no support for Internal Printer Options. Future versions of software may support the control of the internal printer.

(6) -- Pressing row (6) on the touch-screen or the [6] key will put you back to the System Parameters Menu.

(7) -- Pressing row (7) on the touch-screen or the [7] key will bring up a "HELP" screen which gives you a brief description of your possible selections.

Selection: **(4) External Printer Options**
(from System Parameters Menu)

(4) -- Pressing row (4) on the touch-screen or the [4] key will produce a listing of the External Printer Options such as the following:

External Printer Options

Sorry, these functions not supported
in the current software.

(6) Return to System Param. Menu
(7) H E L P !

Presently, there is no support for Extenal Printer Options. Future versions of software may support the control of an external printer.

(6) -- Pressing row (6) on the touch-screen or the [6] key will put you back to the System Parameters Menu.

(7) -- Pressing row (7) on the touch-screen or the [7] key will bring up a "HELP" screen which gives you a brief description of your possible selections from the System Parameters Menu.

Selection: (5) **Toggle Event Scanning On/Off**
(from System Parameters Menu)

Pressing row (5) on the touch-screen or the [5] key will cause the unit to display either:

```
Toggle Event Scanning On/Off

Currently, Event Scanning is On,

Turn Scanning Off?

(Y)es   or   (N)o  =>
```

or

```
Currently, Event Scanning is Off,

Do You Want to Turn it On (Y/N)?
```

For either display you would enter [Y] for "Yes" or [N] or "No". If the current event scanning is "Off", and you press [Y] to turn it "On", the unit will prompt you for what setup (0 through 16) to use. You can then enter the number of the setup. If you press [0], the default setting of the front panel knob will be used. Below is an example of the Initiate a Setup Menu:

```
Initiate a Setup

Enter a Setup Number  1 - 16 or,
Enter 0 to Read the Setup Switch
Enter [X] to Exit
Enter [H] to get HELP!
Then press [RETURN]

Initiate which Setup?  =>
```

Selection: (6) **Return to the Setup Parameters Menu**
(from System Parameters Menu)

Pressing row (6) on the touch-screen or the [6] key will put you back to the Setup Parameters Menu.

Selection: (7) **H E L P !**
(from System Parameters Menu)

Pressing row (7) on the touch-screen or the [7] key will bring up a "HELP" screen which gives you a brief description of your possible selections from the System Parameters Menu and what they mean.

Selection: (4) Initiate Setup
(from Setup Parameters Menu)

Pressing row (4) on the touch-screen or the [4] key will cause the unit to prompt you for the setup you wish to initiate. You may then enter a number 1-16 followed by a [RETURN] to start scanning using a the stored setup with the corresponding number. The actual parameters for each setup can be viewed under the Main Channel Setups Menu which is accessed from the Setup Parameters Menu. If you enter [0] then [RETURN] the unit will read the Setup Switch on the front panel for the setup number to initiate. Pressing [X] then [RETURN] will exit to the Setup Parameters Menu with any changes. Pressing [H] then [RETURN] will display the help screen.

NOTE: If scanning is currently on it will be turned off, then turned back on immediately using the new setup information. If scanning is off, it will be turned on using the new setup information.

Selection: (5) Change Site Information
(from Setup Paramters Menu)

Pressing row (5) on the touch-screen or the [5] key will display he current site information, and ask you if you want to change it. If you press [y], you can then enter a new 42-character description, followed by [RETURN], which will then be used as the site description for that setup. Pressing anything other than [Y] will be interpreted as "No".

2.7.2 Examine a Stored Waveform

Pressing row (2) on the touch-screen or the [2] key while in the Main Menu will put you in the Examine a Stored Waveform screen:

```
To display a stored event, enter
the number followed by [RETURN].

    Enter Event Number =>


Press [RETURN] to display the most recent event.
    Press 'x' followed by [RETURN] to exit.
```

At this point you use the keyboard to enter the number of the event you wish to display (followed by [RETURN]). Events are stored chronologically, with #1 being the oldest. Pressing [RETURN] without entering a number will display the most recent event in memory.

Pressing the "x" key followed by [RETURN] will return you to the Main Menu.

If you select an event number not in memory, or if you enter non-numeric characters (other than the "x" command), you will be asked to enter a new value. You can use the backspace key to correct errors before you press [RETURN].

If you select a valid entry number, the stored waveform will be displayed. An example of such a waveform is illustrated in Figure 2-8:

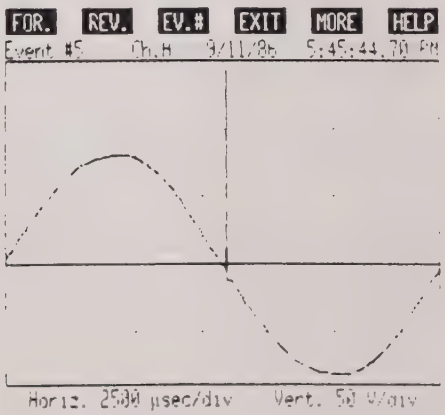


Figure 2-8. Captured Impulse, First Screen

Text Line Below Screen

Horiz. 2500 usec/div -- Each division line as you go from left to right across the screen represents 2500 microseconds.

Vert. 50 V/div -- Each division line as you go from the bottom to the top of the screen represents 50 volts.

Text Line Above Screen

Event #5 -- Indicates this is the fifth event in memory.

Ch.A -- Indicates this is a picture of channel A data.

9/11/86 -- Indicates the date the disturbance occurred.

5:45:44.70 PM -- Indicates the time it occurred.

Touch-Screen Buttons

FOR. -- Pressing this button on the touch-screen or the [F] key advances the display to the next channel for this event, and if it's on channel D, it advances to the next event in memory. For example, if the current event is #16 with channel D being displayed, pressing the button will display event #17, channel A. If the event is on channel D and doesn't increment further, you are at the last event in memory.

REV. -- Pressing this button on the touch-screen or the [R] key brings you back to the previous channel letter, and if it's on channel A, it brings you back to the previous event number in memory.

EV.# -- Pressing this button on the touch-screen or the [E] key puts you back to the Display and Examine Waveforms screen.

EXIT -- Pressing this button on the touch-screen or the [X] key puts you back to the Main Menu.

HELP -- Pressing this button on the touch-screen or the [H] key will give you an explanation of your possible selections from this screen and what they mean.

MORE -- Pressing this button on the touch-screen or the [M] key displays the same waveform, but with the rest of its buttons as illustrated in Figure 2-9 on the following page.

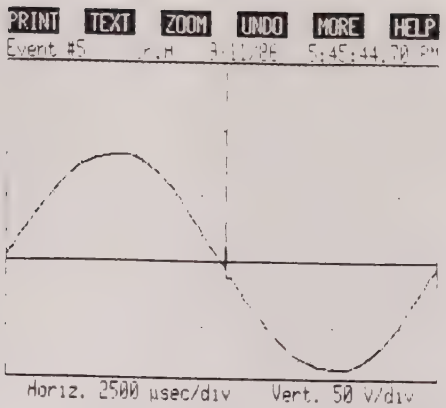


Figure 2-9. Captured Impulse, Second Screen

PRINT -- Pressing this button on the touch-screen or the [P] key will print the currently displayed graph. Pressing the CANCEL button while the unit is printing will stop the printing.

TEXT -- Pressing this button on the touch-screen or the [T] key will give you a description of the displayed disturbance.

MORE -- Pressing this button on the touch-screen or the [M] key returns you to the original screen of Figure 2-8.

HELP -- Pressing this button on the touch-screen or the [H] key will give you an explanation of your possible selections from this screen and what they mean.

ZOOM -- Pressing this button on the touch-screen or the [Z] key puts you in the "Zoom" mode, illustrated in Figure 2-10. An explanation of how you position the zoom-box begins on the next page.

UNDO -- After a waveform has been "zoomed," pressing this button on the touch-screen or the [U] key brings you back to the previous screen. Before a waveform has been "zoomed," this button performs no function.

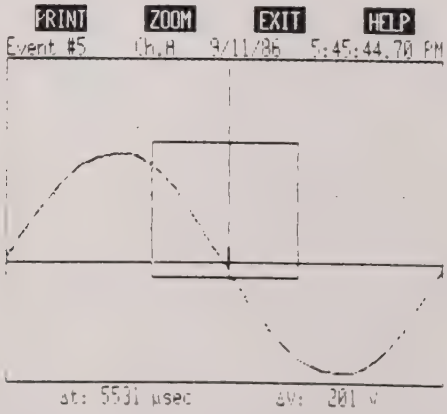


Figure 2-10. Captured Impulse With Zoom-Box

Text Line Below Screen

When at this screen, the text line below the screen changes to the following representations:

Delta t: 5531 usec -- Indicates the width of the zoom-box. This number will change as you change the width of the zoom-box.

Delta V: 201 V -- Indicates the height of the zoom-box. This number will change as you change the height of the zoom-box.

Touch-Screen Buttons

PRINT -- Pressing this button on the touch-screen or the [P] key will print the currently displayed graph. Pressing the CANCEL button while the unit is printing will stop the printing.

ZOOM -- Pressing this button on the touch-screen or the [Z] key while the zoom-box is on the screen, will cause the unit to zoom in on the boxed off region. The region will then be expanded to the full size of the screen. Positioning the zoom-box on the screen is explained below.

EXIT -- Pressing this button on the touch-screen or the [X] key will bring you back to the original picture of the waveform, no matter how many times it was "zoomed."

HELP -- Pressing this button on the touch-screen or the [H] key will give you an explanation of your possible selections from this screen and what they mean.

Positioning the Zoom-Box

The zoom-box is best operated when it is moved to its general position using your index finger (or pointer), as described in Subsection 1.1.2. Then, if you want exact accuracy of where you're positioning the zoom-box, use the keyboard for fine adjustments of each of the four sides.

Pressing the [I] key moves the ceiling of the zoom-box down in slight increments. Pressing [SHIFT]+[I] moves the ceiling of the zoom-box up in slight increments.

Pressing the [M] key moves the floor of the zoom-box up in slight increments. Pressing [SHIFT]+[M] moves the floor of the zoom-box down in slight increments.

Pressing the [J] key moves the left wall of the zoom-box to the right in slight increments. Pressing [SHIFT]+[J] moves the left wall of the zoom-box to the left in slight increments.

Pressing the [K] key moves the right wall of the zoom-box to the left in slight increments. Pressing [SHIFT]+[K] moves the right wall of the zoom-box to the right in slight increments.

Pressing [SHIFT]+[,] to access the left arrow "<", moves the entire zoom-box to the left in slight increments.

Pressing [SHIFT]+[.] to access the right arrow ">", moves the entire zoom-box to the right in slight increments.

An illustration of the six above "move" commands is illustrated in Figure 2-11 below:

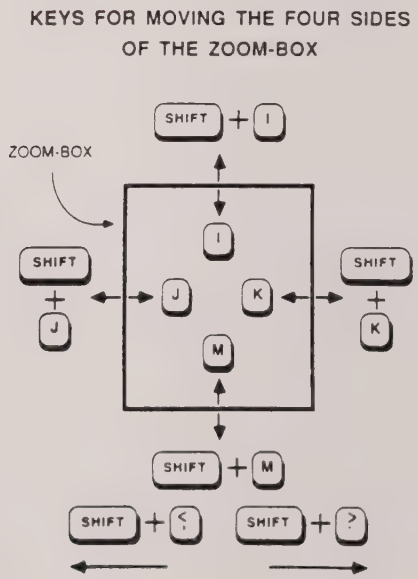


Figure 2-11. Keyboard "Move" Commands for Zoom-Box Positioning

Using the Zoom-Box to Estimate Disturbance Magnitude and Duration

You can continue to zoom in on a disturbance until you have enlarged it to a size where you can reasonably position the zoom-box around it to determine its duration and magnitude.

Figure 2-12 illustrates a positioned zoom-box around a disturbance that has been "zoomed" five times. From the bottom of the display you can see that the width of the zoom-box is 11 microseconds. (If you were to place the walls of the zoom-box exactly on the beginning and end of the disturbance, it would be 9 microseconds.) You can also see that the height of the zoom-box covers 297 volts. (If you were to place the floor and ceiling of the zoom box exactly on the bottom and top of the disturbance, it would be 293 volts.)

Thus, once you have zoomed the picture to a size you can work with, you can then use the zoom-box to estimate the disturbance's duration and magnitude--9 microseconds and 293 volts for the disturbance in Figure 2-12. How close you want to move the zoom-box around the disturbance depends on the amount of accuracy you want.

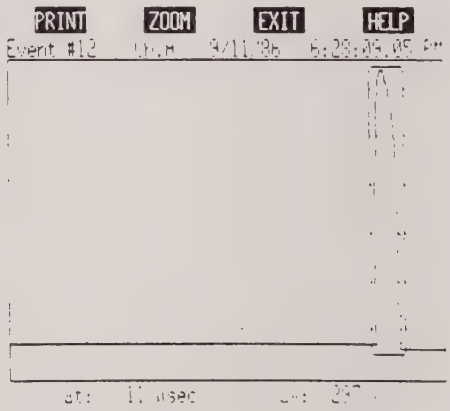


Figure 2-12. Impulse "Zoomed" Five Times

"Zoom" Increments

You could theoretically continue to zoom in on each waveform until you reach either the minimum time or voltage increment: 25 uSec or 2 V. Once this point is reached, the unit will not allow you to zoom in any further.

Table 2-1. Time and Voltage Increments

Time Increments	Voltage Increments
25 uSec	2 V
50 uSec	5 V
100 uSec	10 V
250 uSec	20 V
500 uSec	50 V
1000 uSec	100 V
2500 uSec	200 V
5 mSec	500 V
10 mSec	1000 V
25 mSec	2000 V
50 mSec	
100 mSec	
250 mSec	

2.7.3 Plot a Graphic Summary

Pressing row (3) on the touch-screen or the [3] key while in the Main Menu will put you in the Graphic Summaries Menu which appears as follows:

Graphic Summaries Menu

(1) Plot RMS/Impulse Summary
(2) Plot Sensor Channel Summary
(3) Plot Frequency Summary

(6) Return to Main Menu
(7) H E L P !

Pressing row (1) on the touch-screen or the [1] key while in the Graphic Summaries Menu will put you in the Plot RMS/Impulse Menu. See section 2.7.3.1 for details.

Pressing row (2) on the touch-screen or the [2] key will put you in the Plot Sensor Channel Menu. Its operation is identical to that of the Plot RMS/Impulse Menu, except that the purpose is to create a summary plot of a sensor channel. Also, item #1 in the Plot Sensor Channel Menu selects channels S1 through S8 instead of main channels A through D.

Presing row (3) on the touch-screen or the [3] key will put you in the Plot Frequency Menu. Its operation is identical to that of the Plot RMS/Impulse Menu, except that the purpose is to create a summary plot of the line frequency seen by the main channel inputs. Also, there is no item #1 in the Plot Frequency Menu, since there is no channel selection to be made. (All of the main channels are intended to be connected to either DC voltages or AC voltages with one common frequency.)

Pressing row (6) on the touch-screen or the [6] key will return you to the Main Menu.

Pressing row (7) on the touch-screen or the [7] key will bring up a "HELP" screen describing the possible selections in the Graphic Summaries Menu and what they mean.

2.7.3.1 Plot RMS/Impulse Menu

Pressing row (3) on the touch-screen or the [3] key while in the Main Menu will put you in the Plot RMS/Impulse Summary Menu which appears as follows:

Plot RMS/Impulse Summary Menu

(1) Channel to be Plotted: A
(2) Plot Previous 24 Hours
(3) Plot Previous Hour
(4) Plot Any Day by Hour...
(5) Plot Multiple Days...
(6) Return to Previous Menu
(7) H E L P !

Selection: **(1) Channel to be Plotted: A**
(from Plot RMS/Impulse Menu)

Pressing row (1) on the touch-screen or the [1] key will change the channel letter from "A" to "B" to "C" to "D" to "A" to "B" to "C" to "D", etc.

Application: This determines the channel you are going to plot (you can only plot one channel at a time).

Selection: **(2) Plot Previous 24 Hours**
(from Plot RMS/Impulse Menu)

Pressing row (2) on the touch-screen or the [2] key will produce two plots of the last 24 hours: An RMS Summary and an Impulse Summary. An example of such a plot appears in Figure 2-13 below:

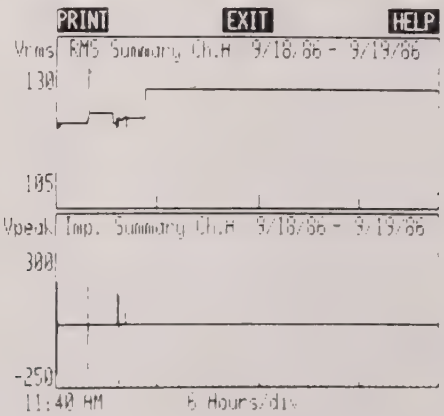


Figure 2-13. 24-Hour Plot

In the example of the Figure 2-13, the 24-hour plot was performed at 11:40 a.m., on September 19, 1986. This is indicated by the time of the plot in the lower left-hand corner and the date interval in the upper right-hand corner. Note that the plot spans from 11:40 a.m. on 9/18/86 through 11:40 a.m. on 9/19/1986 (24 hours). The three vertical lines at the bottom of each plot are the 6-hour reference divisions.

Impulse Summary Plot

The bottom plot indicates an impulse summary on channel A (as determined by selection (1) in the Plot RMS/Impulse Summary Menu). From the plot you can see that impulses in the last hour occurred at about 11:40 a.m., 1:40 a.m., 3:40 a.m., 3:45 a.m., and 4:00 p.m. The magnitude of these impulses can be determined by the vertical scale (-250V to +300V).

RMS Summary Plot

The top plot indicates an rms summary on channel A (as determined by selection (1) in the Plot RMS/Impulse Summary Menu). From the plot you can see that the rms voltage changed several times in the first six hours. The magnitude of the changes can be determined by the vertical scale (105V rms to 130V rms).

Selection: **(3) Plot Previous Hour**
(from Plot RMS/Impulse Menu)

Pressing row (3) on the touch-screen or the [3] key will produce two plots of the last hour: An RMS Summary and an Impulse Summary. An example of such a plot appears in Figure 2-14 below:

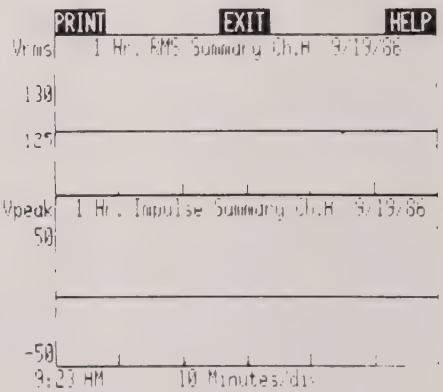


Figure 2-14. Previous Hour Plot

In the example of Figure 2-14, the previous hour plot was performed at 10:23 a.m., on September 19, 1986 (the starting time is 9:23 a.m.). The five vertical lines at the bottom of each plot are the 10-minute reference divisions.

Impulse Summary Plot
The bottom plot indicates an impulse summary on channel A (as determined by selection (1) in the Plot RMS/Impulse Summary Menu). From the plot you can quickly see that there were no impulses recorded in the last hour.

RMS Summary Plot
The top plot indicates an rms summary on channel A (as determined by selection (1) in the Plot RMS/Impulse Summary Menu). From the plot you can quickly see that there were no rms changes recorded in the last hour.

Selection: **(4) Plot Any Day by Hour**
(from Plot RMS/Impulse Menu)

Pressing row (4) on the touch-screen or the [4] key will produce a screen which prompts you for the plot date, starting hour, and ending hour. The complete screen, excluding your entries, will appear as follows:

```
                Plot Any Day by Hour

          Plot Date  mm/dd/yy =>
          Start Hour    hh XM =>
          End Hour      hh XM =>


                Press 'G' to go.


          H: Help  S: Start Over  X: Exit
```

Example Dates: 5/25/86, 9/13/86, 10/1/86, etc.

Example Hours: 12 am (midnight), 12 pm (noon), 1 pm, 11 am, etc.

Pressing [H] brings up a "HELP" screen, pressing [S] allows you to restart your entries, and pressing [X] exits you to the RMS/Impulse Summary Menu.

Once you have entered the plot date, starting hour, ending hour, and have pressed the [G] key, two plots (RMS and Impulse Summaries) such as the ones in Figure 2-15 will be displayed.

Figure 2-15 below illustrates a 4-hour summary of September 19, 1986, from 12 a.m. to 4 a.m. The two plots are read the same as those in Figures 2-13 and 2-14. In this figure, however, there are seven vertical lines at the bottom of each plot, indicating 30-minute reference divisions.

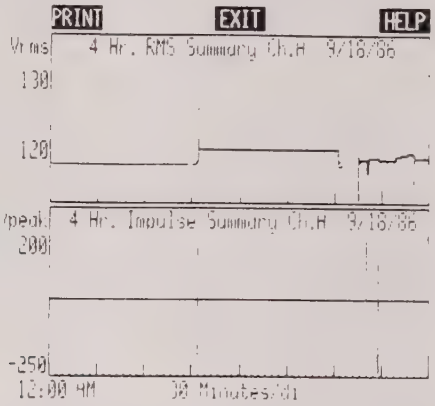


Figure 2-15. 4-Hour Plot

Selection: **(5) Plot Multiple Days**
(from Plot RMS/Impulse Menu)

Pressing row (5) on the touch-screen or the [5] key will produce a screen which prompts you for the starting and ending plot dates. The complete screen, excluding your entries, will appear as follows:

```
                Plot Multiple Days

Start Date  mm/dd/yy =>
End Date    mm/dd/yy =>


                Press 'G' to go.


          H: Help  S: Start Over  X: Exit
```

Example Dates: 5/25/86, 9/13/86, 10/1/86, etc.

Pressing [H] brings up a "HELP" screen, pressing [S] allows you to restart your entries, and pressing [X] exits you to the RMS/Impulse Summary Menu.

Once you have entered the dates, and have pressed the [G] key, two plots (RMS and Impulse Summaries) such as the ones in Figure 2-16 will be displayed.

Figure 2-16 below illustrates a 2-day summary of September 18, 1986 through September 19, 1986. The two plots read the same as those in Figures 2-13, 2-14, and 2-15. In this figure, however, there are two vertical lines at the bottom of each plot, indicating 12-hour reference divisions. (The sizes of the reference divisions for these plots are a factor of the number of days you are plotting.)

NOTE

The starting time is 11:40 a.m., not 12:00 (midnight) as you would expect. This is because the first impulse or rms change in memory did not occur until 11:40 a.m. of the first day you are plotting. For example, if you were to try to plot September 12, 1986 through September 19, 1986, and the first impulse occurred at 11:40 a.m. on September 18, 1986, the plot would only run for the last two days--because there was no data reported for the first six days.

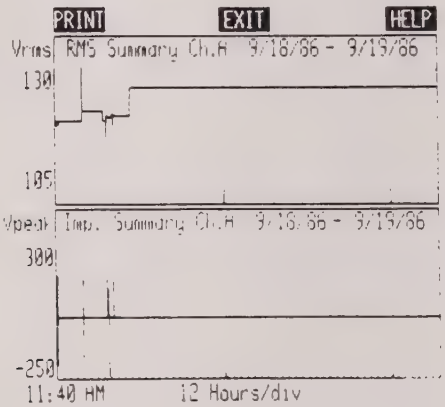


Figure 2-16. Multiple Days Plot

Selection: **(6) Return to** Previous Menu
(from Plot RMS/Impulse Menu)

Pressing row (6) on the touch-screen or the [6] key will put you back to the Graphic Summaries Menu.

Selection: **(7) H E L P !**
(from Plot RMS/Impulse Menu)

Pressing row (7) on the touch-screen or the [7] key will bring up a "HELP" screen which describes your possible selections from the Plot RMS/Impulse Menu and what they mean.

2.7.4 Written Summaries Menu

Pressing row (4) on the touch-screen or the [4] key while in the Main Menu will put you in the Written Summaries Menu. The menu display is as follows:

```
        Written Summaries Menu
(1) Summarize All Events
(2) Summarize Events by Channel
(3) Summarize Events by Type

(6) Return to Main Menu
(7) H E L P !
```

Selection: (1) Summarize All Events

Pressing row (1) on the touch-screen or the [1] key while in the Written Summaries Menu will enable you to create a written summary of all events in chronological order. After selecting this option you will be asked to choose a printout mode (see section 2.7.4.1 .

Selection: (2) Summarize Events by Channel

Pressing row (2) on the touch-screen or the [2] key will enable you to create a summary of only one of the four main channels or of the sensor channels. It will cause the following menu to appear:

```
Summarize Events by Channel Menu
(1) Summarize Channel A Events
(2) Summarize Channel B Events
(3) Summarize Channel C Events
(4) Summarize Channel D Events
(5) Summarize Sensor Ch. Events
(6) Return to Written Sum'y Menu
(7) H E L P !
```

Select one of items (1) through (5) to specify which channel's events you want to summarize. You will then be asked to choose a prinout mode (see section 2.7.4.1).

Selection: (3) Summarize Events by Type (from Written Summaries Me.

Pressing row (3) on the touch-screen or the [3] key from the Writte. Summaries Menu will enable you to create a summary of specific t.. of main channel disturbances. It will cause the following menu to appear:

```
 Summarize Events by Type Menu
(1) Summarize RMS Changes
(2) Summarize Voltage Dropouts
(3) Summarize HF Occurences
(4) Summarize Frequency Changes

(6) Return to Written Sum'y Menu
(7) H E L P !
```

Choose one of selections (1) through (4) to summarize RMS voltage changes, voltage dropouts, high-frequency impulses/noise, or AC voltage frequency changes. The summary will contain all the events of the chosen type, regardless of the channel they occurred on. After making your selection, you will be asked to choose a printout mode (see section 2.7.4.1).

Selection: (6) Return to Main Menu (from Written Summaries Menu)
(7) H E L P ! " " " "

Choose selection (6) to return to the Main Menu. Choose selection (7) to get a help screen giving a brief description of the options in the Written Summaries Menu.

2.7.4.1 Choosing a Printout Mode

After making a selection on what type of events to summarize (as described in section 2.7.4), the following screen will appear:

Choose A Printout Mode:
(1) Print All Summary Items
(2) Print Selected Summary Items
(3) Do Not Print

(6) Return to Written Sum'y Menu
(7) H E L P !

All summaries will be written to the screen. Choose one of selections (1) through (3) based on whether or not you also wish to have a permanent "hardcopy" printout of the summary. Selection 1 will print all summary items automatically, so that you can initiate the summary sequence, leave the unit, and come back when the summary has completed. You will still be able to stop the summary if you desire (see section 2.7.4.2). Selection (2) will only print those items you select, so that you can edit the printout. Selection (3) will display the summary on the screen only.

2.7.4.2 Viewing a Written Summary

After selecting a printout mode, the first summary item will appear on the screen. A sample printout is shown below. Each summary item contains three lines. The top line shows the date and time of occurrence, event #, and channel. The next 2 lines contain information specific to the type of event that it is. Your options will vary depeding on what printout mode you selected.

If you chose to print all summary items, the printer will have automatically started to print the information. When the printout is finished, the next item will automatically be displayed and printed. In this case, the only option you have is to abort the summary or wait for it to finish. Aborting the summary can be accomplished by pressing the [x] key at any time.

If you chose to print selected summary items, you will see four menu buttons on the top portion of the screen. They are similar to the buttons in the "Examine" feature of the 656. Pressing "PRINT" on the touch-screen or the [P] key will cause the current item to be printed. You will not be able to make another selection while the printout is in progress. Pressing "NEXT" on the touch-screen or the [N] key will erase the current summary item from the screen and replace it with the next one. After the last summary item a final screen gives details on the number of items in the summary. Pressing "EXIT" or the [X] key will abort the summary. Pressing "HELP" or the [H] key will produce a help screen outlining your options.

If you chose to not print any items, you will see three menu buttons on the top portion of the screen: "NEXT", "EXIT", and "HELP". See the above paragraph for a description of their use.

```
Mon 12/01/86 06:11:46.37p Ev #9 Ch. H
Vrms: min=122.8 max=125.1
HF Hits:1 Worst:+127V,  137us, 266deg

Mon 12/01/86 06:02:34.73p Ev #8 Ch. A
Vrms: min=125.1 max=125.1
HF Hits:1 Worst:-249V,  228us, 15deg

Mon 12/01/86 05:22:26.57p Ev #6 Ch. A
Vrms: min=123.0 max=124.0
HF Hits:1 Worst:-152V,  47us, 189deg
```

Figure 2-17. Three Sample Summary Items

2.7.5 Disk Operations Menu

Pressing row (5) on the touch-screen or the [5] key while in the Main Menu will put you in the Disk Operations Menu. The Disk Operations Menu display appears as follows:

```
                Disk Operations Menu
          (1) Get Information From Disk...
          (2) Save Information to Disk...
          (3) Initialize a New Disk
          (4) Make a Duplicate Disk

          (6) Return to the MAIN MENU
          (7) H E L P !

   Selection: (1) Get Information From Disk
                  (from Disk Operations Menu)
```

Pressing row (1) on the touch-screen or the [1] key will produce the following display:

```
                Get Information From Disk


          Place the disk to be loaded into
          the LEFT disk drive (with the
          label facing the CRT).

            Press any key when ready...
```

At this point you should insert the 656 Data Disk that you want to load into the system. It may contain Events, Setups, or both Events and Setups. After you have inserted the disk, press any key. The 656 will now determine what is stored on the disk and how it should be loaded. If the disk doesn't contain any valid 656 Data, the following screen will be displayed:

```
          Sorry, the disk in the LEFT
          disk drive does not contain
          valid 656 Events or Setups.
          It cannot be loaded.

          Press any key to continue
```

Loading a Disk That Contains Only Events:

If the disk is found to contain only Events, the following screen is displayed:

```
                Get Information From Disk

          This disk contains Events Only.
          Loading it will replace the
          Events in memory with the ones
          contained on the disk.
          Start Loading Events? [Y] or [N]
```

You should now press [Y] to confirm that you want the 656 to load the Events only disk. Pressing [N] (or any other key than [Y]) will not load the disk data and will return you to the Disk Operations Menu. If you press [Y] a status screen is then displayed showing the remaining tracks to tranfer. Upon successful completion, the screen will display that the transfer was successful and you should press any key to continue. Any errors occurring on the transfer will be displayed along with a message stating the transfer failed and you should press any key to continue.

Application: You can reload previously stored events for examination and analysis.

Loading a Disk That Contains Only Setups:
If the disk is found to contain only Setups, the following screen is displayed:

Get Information From Disk

This disk contains Setups Only.
Loading it will replace the
Setups in memory with the ones
contained on the disk.
Start Loading Setups? [Y] or [N]

You should now press [Y] to confirm that you want the 656 to load the Setups only disk. Pressing [N] (or any other key than [Y]) will not load the disk data and will return you to the Disk Operations Menu. If you press [Y] a status screen is then displayed showing the remaining tracks to tranfer. Upon successful completion, the screen will display that the transfer was successful and you should press any key to continue. Any errors occurring on the transfer will be displayed along with a message stating the transfer failed and you should press any key to continue.

Application: You can create and load the 656 with customized setups for your own specific applications.

Loading a Disk That Contains Both Events and Setups:
If the disk is found to contain both Events and Setups, the following screen is displayed:

Get Information From Disk

This disk contains both Events
and Setups. Loading it will
replace the Events and Setups in
memory with the ones contained
on the disk. Start loading both
Events and Setups? [Y] or [N]

You should now press [Y] to confirm that you want the 656 to load the Events and Setups on the disk. Pressing [N] (or any

other key than [Y]) will not load the disk data and will return you to the Disk Operations Menu. If you press [Y] a status screen is then displayed showing the remaining tracks to transfer. Upon successful completion, the screen will display that the transfer was successful and you should press any key to continue. Any errors occurring on the transfer will be displayed along with a message stating the transfer failed and you should press any key to continue.

Application: This feature is useful to restore the events and setups that have been stored previously on your 656 or another 656.

A General Note About Aborted and Failed Disk Loadings:

All three disk loading functions allow you to abort the loading procedure. However, an aborted disk loading or a disk error occurring during loading can leave the 656 Event Memory with possibly faultly and erroneous data in it. So that the 656 will not be left in this unacceptable state, after an aborted or failed disk loading the Event Memory will be cleared and the Setups returned to their original factory settings. Again, this is to assure that the Event Memory is not corrupted. When this happens the following screen is displayed:

Transfer From Disk ABORTED!

Event memory has been cleared
and the Setups have been reset
in order to remove any bad data
that may have been transfered.

Press any key to continue

(A similar screen appears for failed transfers from disk.)

Selection : (2) Save Information to Disk
(from Disk Operations Menu)

Pressing row (2) on the touch-screen or the [2] key will produce the Save Information to Disk Menu as follows:

Save Information To Disk
(1) Save Events
(2) Save Setups
(3) Save Both Events and Setups

(6) Return to Disk Operat. Menu
(7) H E L P !

(1) -- Pressing row (1) on the touch-screen or the [1] key

will save the events that are currently in memory to the disk. Note that these events can be retrieved from the disk at some future time using the 'Get Information From Disk' feature. The following screen is displayed:

Save Event Memory To Disk

Insert the destination disk into
the LEFT disk drive.
CAUTION: This will wipe out all
previously stored data on this
disk!

Start saving events? (Y) or (N)

At this point you can press [N] to exit the screen without doing anything or you should insert the disk into the left disk drive and press [Y]. A status screen is then displayed showing the remaining tracks to transfer. Upon successful completion the screen will display that the transfer was successful and you should press any key to continue. Any errors occurring on the transfer will be displayed along with a message stating the transfer failed and you should press any key to continue.

Application: You can save important events to disk for future reference and/or analysis.

(2) -- Pressing row (2) on the touch-screen or the [2] key will save the current setups to disk. Note that these setups can be retrieved from the disk at some future time using the 'Get Information From Disk' feature. The following screen is displayed:

Save Setups to Disk

Insert the destination disk into
the LEFT disk drive.
CAUTION: This will wipe out all
other data that is currently on
this disk!

Start saving Setups? (Y) or (N)

At this point you can press [N] to exit the screen without doing anything or you should insert the disk into the left disk drive and press [Y]. A status screen is then displayed showing the remaining tracks to transfer. Upon successful completion the screen will display that the transfer was successful and you should press any key to continue. Any errors occurring on the transfer will be displayed along with a message stating the transfer failed and you should press any key to continue.

Application: You can save the current 656 setups to disk for future recall.

(3) -- Presing row (3) on the touch-screen or the [3] key will save both events and setups to disk. Note that these setups and events can be retrieved from the disk at some future time by using the 'Get Information From Disk' feature. The following screen is dispalyed:

Save Events and Setups To Disk

Insert the destination disk into
the LEFT disk drive.
CAUTION: This will wipe out all
previously stored data on this
disk!

Save Events & Setups (Y) or (N)

At this point you can press [N] to exit the screen without doing anything or you should insert the disk into the left disk drive and press [Y]. A status screen is then displayed showing the remaining tracks to transfer. Upon successful completion the screen will display that the transfer was successful and you should press any key to continue. Any errors occurring on the transfer will be displayed along with a message stating the transfer failed and you should press any key to continue.

Application: This feature saves both events and setups and is useful when you desire to save both for future use.

There are no selections (4) and (5) in the Save Information to Disk Menu.

(6) -- Pressing row (6) on the touch-screen or the [6] key will return you to the Disk Operations Menu.

(7) -- Pressing row (7) on the touch-screen or the [7] key will display the HELP screen.

(Remainder of page left intentionally blank.)

Selection: (3) Initialize a New Disk
(from Disk Operations Menu)

Pressing row (3) on the touch-screen or the [3] key will produce the following screen:

Initialize a New Disk

Insert the disk to be initialized into the LEFT disk drive.
CAUTION: Initializing a disk wipes out any data that was previously stored on it.
Start initializing? (Y),(N),(H)

Three responses are valid:

[Y]: Pressing [Y] will begin the initializing process. Before you press [Y] the disk you want to initialize should be in the left disk drive. Initializing a disk is a two step process. First the disk is initialized, then it is verified for data integrity. With both operation there are status screens to relay the progress of each operation. Upon successful completion a message will display stating as much and you will be asked to press any key to continue. If an error occurrs along the way it also will be displayed and the initialization will be aborted.

[N]: Pressing [N] will exit return you immediately to the Disk Operations Menu without initializing the disk.

[H]: Pressing [H] wil display the HELP screen.

Application: A brand new disk, fresh from the box, must be initialized so that it can be used with the 656. All disk used with the 656 -must- be initialized before they can be used. Initializing also check the disk and verifies its ability to store data reliably. Once a disk has been initialized it can be used over and over again without having to reinitialize it.

Selection: (4) Initialize a New Disk
(from Disk Operations Menu)

Pressing row (4) on the touch-screen or the [4] key will produce the following screen:

Make a Duplicate Disk

Insert the source disk into the RIGHT disk drive. Insert an initialized disk into the LEFT drive as the destination disk.
CAUTION: All data on the destination disk will be copied over.
Start copy process? (Y),(N),(H)

Three responses are valid:

[Y]: Pressing [Y] will begin the copying process. Before you press [Y] both the source and the destination disk should be in the proper drives as specified by the screen. The copying will begin and a status screen will be displayed. Upon successful completion the a message will be displayed and you will be asked to press any key. If an error occurrs along the way it will also will be displayed and the copying process will be aborted.

[N]: Pressing [N] will exit return you immediately to the Disk Operations Menu without initializing the disk.

[H]: Pressing [H] wil display the HELP screen.

Application: Any 656 disk can be copied using this feature. It's a good idea to make 'backups' (extra copies) of your most important disks. That way, if anything happens to your original disk you can use the backup copy to make another.

Selection: (6) Return to MAIN MENU
(from Disk Operations Menu)

Pressing row (6) on the touch-screen or the [6] key will return you to the MAIN MENU

Selection: (7) H E L P !
(from Disk Operations Menu)

Pressing row (7) on the touch-screen or the [7] key will display the help screen.

2.7.6 Other System Functions Menu

Pressing row (6) on the touch-screen or the [6] key while in the Main Menu will put you in the Other Systems Functions Menu. The Other System Functions Menu appears as follows:

Other System Functions Menu
(1) Set Time and/or Date
(2) Turn Beeper Off*
(3) Display System Status
(4) Delete ALL Events in Memory
(5) 656 System Tools...
(6) Return to MAIN MENU
(7) H E L P !

* This entry could also read 'Turn Beeper On' depending on the current beeper status.

Selection: (1) Set Time and/or Date
(from Other System Functions Menu)

Pressing row (1) on the touch-screen or the [1] key will display the following screen (assume 12/09/86, 4:38:05 PM):

```
Set/Display Time and Date
(1) Set the Time
(2) Set the Date

Time: 4:38:05 PM
Tuesday, December 9, 1986

(6) Return to the Previous Menu
(7) H E L P !
```

(1) -- Pressing the [1] key will display:

```
Enter Current Time in 24 Format
e.g.  AM/PM TIME      ENTER
      -----------     --------
     12:05:41 AM => 00:05:41
      9:05:23 AM => 09:05:23
      5:21:38 PM => 17:21:38
Note: enter 1-9 as 01-09

Set time (hh:mm:ss) =>
```

You should now enter the correct time in 24 hour 'military' format as specified above followed by [RETURN]. Any entry that doesn't follow that format will be indicated by an error message. Time should be set from some known accurate time source. The new time will entered after the [RETURN] key is pressed.

(2) -- Pressing the [2] key will display:

```
Enter Current Date
(mm/dd/yy) =>
```

You should now enter the correct date followed by the [RETURN] per the above format where:

mm = Number of the month (January = 1, December = 12)
dd = Today's date
yy = The last two digits of the current year (1986 = 86)

If you enter a the date incorrectly an error message will be displayed.

(6) -- Pressing the [6] key will return you to the Other System Functions Menu.

(7) -- Pressing the [7] key will display the HELP screen.

Selection: (2) Turn Beeper Off / Turn Beeper On
(from Other System Functions Menu)

Pressing row (2) on the touch-screen or the [2] key will perform the action stated. What Selection (2) says depends on the current state of the beeper: if the beeper is on Selection (2) will read 'Turn Beeper Off'; if the beeper is off Selection (2) will read 'Turn Beeper On'.

Selection: (3) Display System Status
(from Other System Functions Menu)

Pressing row (3) on the touch-screen or the [3] key will display the following: (Note that this is a representative screen and is used for illustrative purposes only.)

```
                656 System Status Screen
a -->  Time: 9:51:37 AM
b -->  Wednesday, December 10, 1986
c -->  Event Scanning is ON
d -->  Active Setup: 1    Knob: 1  <-- e
f -->  Beeper is ON
g -->  Events in Memory: 457
h -->  Event Memory 38% full
       Touch here or press any key...
```

Several different types of information about the 656 can be gained from this screen.

(a) This was the current time when the status screen was first called up.

(b) This was the current date when the status screen was first called up.

Note: The time and date do not run continuously on this screen.

(c) This line tells the current status of event scanning.

(d) The number of the active setup is displayed here. The active setup is the setup whose parameters were used when scanning was turned on last.

(e) The position of the Setup Switch Knob is displayed here. This number will change as the knob is turned so that it can be conveniently set to correspond to the desired setup.

(f) The current state of the beeper is stated in this line.

(g) This is the total number of events in memory. This include all types of events the 656 can generate.

(h) This line tells you how full event memory is as a percent.

After you are done viewing the status screen you may either press any key or the touch-screen to return you to the Other Systems Functions Menu.

Selection: (4) Delete ALL Events In Memory
(from Other System Functions Menu)

Pressing row (4) on the touch-screen or the [4] key will display the following:

```
Delete ALL Events In Memory

CAUTION! ONCE EVENT MEMORY HAS
BEEN ERASED, IT CAN NEVER BE
RECOVERED!

Are you SURE you want to delete
every event in memory?
(Y)es or (N)o =>
```

If you now press [N], you will be returned to the Other System Functions Menu without deleting any events. If you press [Y], event memory will be erased so that there will be zero events in memory and the next event that occurs will be numbered '1'. A screen will be displayed informing you that event memory has been erased and that you should press any key to continue.

Application: When event memory fills up, use this feature to 'wipe the slate clean', removing all the old events. If you are interested in keeping any of the events, you should save them to disk before you delete them so you can have a permanent record of them.

Selection: (5) 656 System Tools...
(from Other System Functions Menu)

```
§§§
```

you will not be allowed access to the System Tools Menu. After entering the proper access code, the following is displayed:

```
        656 System Tools Menu
(1) Touch-screen Cal. Routine
(2) 656 System Self-test



(6) Return to the Previous Menu
(7) H E L P !
```

Pressing row (1) on the touch-screen or the [1] key will display the following:

TOUCHSCREEN CALIBRATION

Type '*' to enter the calibration routine. Instructions will guide you through the procedure.

Type 'X' to exit to the previous menu.

Type 'T' to test the calibration. This option turns the screen into a blackboard you can draw on with your finger. The following keyboard options can be used:

C - Clear the blackboard
P - Print the blackboard
H - Return to this screen (HELP)
X - Exit to the previous menu

As stated above, to calibrate the touch-screen, press the [*] key. Instructions will be displayed telling you to press with a pointed impliment on the top left corner of the displayed rectangle. Now press any key while still pressing the corner. You will be prompted to now press the lower right corner and press any key. Calibration is now complete and you should press any key. The screen now will display a '+' sign in the middle of the screen. In order to verify that the touch-screen is properly callibrated, press on the center of this '+' sign and while holding it, press any key. If successful, a message will be displayed stating this and that you should press any key. However, if the calibration is unsuccessful (as stated by the displayed message) you must repeat the calibration procedure in order for the touch-screen to work.

(2) -- 656 System Self Test

Pressing row (5) or the [5] key will initiate the self-test routine. Each subsystem will be evaluated and its preformance displayed. After the Self-test is over, press any key to return to the Other System Functions Menu.

There are no options (3), (4) or (5) on the 656 System Tools Menu.

(6) -- Return to the Previous Menu

Pressing row (6) or the [6] key will return you to the Other System Functions Menu.

(7) -- H E L P !

Pressing row (7) or the [7] key will display the HELP screen.

SECTION III
OPERATIONAL TEST

3.1 GENERAL

The Series 656 is designed to automatically perform a diagnostics self-test each time it is turned on. The self-test checks out the integrity of the various subsystems.

3.1.1 System OK

If no malfunctions are detected, the initial start-up screen will be displayed.

3.1.2 Malfunction(s) Detected

Any malfunctions detected are listed descriptively, along with what action you should take.

For Example:

S E L F - T E S T
F A I L U R E !

A CPU System Failure occurred!
Turning the unit off and on may
correct this problem. If this
message appears again, the unit
must be repaired. If so, please
call Dranetz Service Corp.

You should then go to the FACTORY REPAIR subsection in this manual (1.11) for further instructions on contacting Dranetz Service Corp.